FEBRUARY

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

Identification by Dental Means—*Rogers*
Pulpless and Infected Teeth—*Hatton et al.*
Repair and Resistance to Infection—*Keeton*
Maxillary Sinus—*Ennis & Batson*
Full Denture Construction—*Sears*
Malignant Diseases of Mouth—*Figi*
Endocrine Disorders & Dental Disease—*Hutton*
Plastic Surgery; Psychic Reactions—*Blair*
Local Anesthetics—*Puterbaugh*
Topical Anesthetics—*Tainter & Moose*
Local Anesthesia, Clinical Application—*Clark*
Relationship of Medicine to Dentistry—*Allen*
Dental Arch Growth—*Lewis*

EDITORIALS
Identification of Dead from Dental Records
One Phase of Dental Teaching

COUNCIL ON DENTAL THERAPEUTICS
Topical Anesthesia—*Tainter & Moose*

BUREAU OF PUBLIC RELATIONS
Statistical Study of Caries—*Cohen*

DENTAL ECONOMICS
Way Out of Economic Chaos—*Garrett*

FIFTY CENTS

CONTENTS

Fred R. Adams, D.D.S. ..... Frontispiece

ORIGINAL COMMUNICATIONS

Identification by Dental Means.
By Alfred Paul Rogers, D.D.S. 181
A Comparison of Roentgen Ray, Transillumination and Bacteriologic Examination of Pulpless and Infected Teeth.
By Edward H. Hatton, B.L., M.D.; F. Jiminez, J. V. Lenberg and Wallie McMurrough 190
Factors in Tissue Repair and Resistance to Infection.
By Robert W. Keeton, M.D. 194
Variations of the Maxillary Sinus as Seen in the Roentgenogram.
By Le Roy M. Ennis, D.D.S., and Oscar Batson, M.D. 201
Escaping the Commonplace in Full Denture Construction.
By Victor H. Sears, D.D.S. 212
Malignant Diseases of the Mouth.
By Frederick A. Figi, M.D. 216
A Dentigerous Cyst Containing Thirty-Three Small Teeth.
By P. Chung, G.D.S., and J. L. Boots, D.D.S., F.A.C.D. 225
Relation of Endocrine Disorders to Dental Disease.
By James H. Hutton, M.D. 226
Plastic Surgery of the Head, Face and Neck; The Psychic Reactions.
By Vilray P. Blair, M.D., F.A.C.S. 236
Administration of Local Anesthetics in Dentistry.
By P. G. Puterbaugh, M.D., D.D.S. 241
Studies in Topical Anesthetics. I The Efficacy of Certain Common Anesthetics When Used on the Gums.
By M. L. Tainter, M.D., and S. M. Moose, D.D.S., F.A.C.D. 244
Research in Local Anesthesia and Its Clinical Application.
By Stanley W. Clark, D.D.S., M.S.D., LL.B., F.A.C.D. 251
Relationship of Medicine to Dentistry.
By Edgar V. Allen, M.D. 254
Treatment of Traumatic Ulcers.
By Edward C. Dobbs, D.D.S. 260
The Solar Teeth.
By Lawrence Parmley Brown, D.D.S. 262
Some Aspects of Dental Arch Growth.
By Samuel J. Lewis, D.D.S. 277
A Reply to Becks and Simmonds' Criticism.
By Martha R. Jones, Ph.D; Nils P. Larson, M.D., and George P. Pritchard, D.D.S. 295
Certified Zinc Phosphate Cements 299

EDITORIAL DEPARTMENT

Identification of the Dead from Dental Records.—One Phase of Dental Teaching 300-305

Practice in Paragraphs 306

COUNCIL ON DENTAL THERAPEUTICS

Accepted Dental Remedies 308
The Practical Value and Limitations of Topical Anesthesia in Oral Surgery.
By M. L. Tainter, M.D., and S. M. Moose, D.D.S., F.A.C.D. 309

BUREAU OF PUBLIC RELATIONS

A Statistical Study of Caries in the Deciduous and Permanent Teeth of Children.
By Joseph T. Cohen, D.D.S. 312

DENTAL ECONOMICS

The Way Out of Economic Chaos.
By Ross Garrett 326
The "Washington Plan."
By Seymour A. Watsky, D.D.S. 338

CURRENT LITERATURE

Abstracts 340

MISCELLANY

Book Reviews 344
Correspondence 344
"The Coil Spring" 345
News 348

Announcements 349

ADVERTISEMENTS

Index to Advertisements A-49
Classified Section A-36

The Journal of the American Dental Association. Vol. XXIII, No. 2. Published by the American Dental Association, 212 East Superior Street, Chicago, Ill. Yearly subscription $5.00. Entered as second-class matter, May 1, 1928, at the postoffice at Chicago, Ill., under the act of Aug. 24, 1912. Published monthly.

Copyright, 1936, by the American Dental Association.

FRED R. ADAMS, D.D.S., New York City
Vice President of the American Dental Association

THE JOURNAL
of the AMERICAN DENTAL ASSOCIATION

Vol. 23 FEBRUARY, 1936 No. 2

Original Communications

IDENTIFICATION BY DENTAL MEANS*

By ALFRED PAUL ROGERS, D.D.S., Boston, Mass.

IT frequently happens that men educated especially for professional service are called on to give of their knowledge and expertness for the benefit of humanity in a different and entirely unexpected field. Such extension of service, beyond the horizon of its customary function, is a frequent experience of the medical profession. Identification of unknown persons after great disasters, or the identification of persons who have met death in such fashion as to be unrecognizable by friends or relatives has been made positive through the efforts of the professions of medicine and dentistry, constituting an inestimable service to society.

Recently, there has come to the dental profession a request from the State Attorney of Vermont for the assistance of the dentist in the identification of three victims of a tragedy which is shrouded in the deepest mystery.

The State Attorney of Vermont realizes that the identification of these three persons is practically impossible without research on the part of the dental profession. It is my purpose today to furnish a brief description of the victims and the dental work found in the two older in order to increase our chance of rendering an important service to society.

On the sixteenth day of May, 1935, three skeletons were discovered in a shallow grave a short distance from an unused wood road near East Middlebury, Vt. The first was that of an adult female, the second thought to be that of a boy 13 years of age and the third that of a child about 11 years of age of undetermined sex. The consensus of opinion is that these bodies have been in this position for from four to six years. The most startling thing regarding the discovery is the unmistakable evidence of foul play, for each had been shot through

*Read before the Section on Orthodontia at the Seventy-Seventh Annual Session of the American Dental Association, New Orleans, La., Nov. 6, 1935.

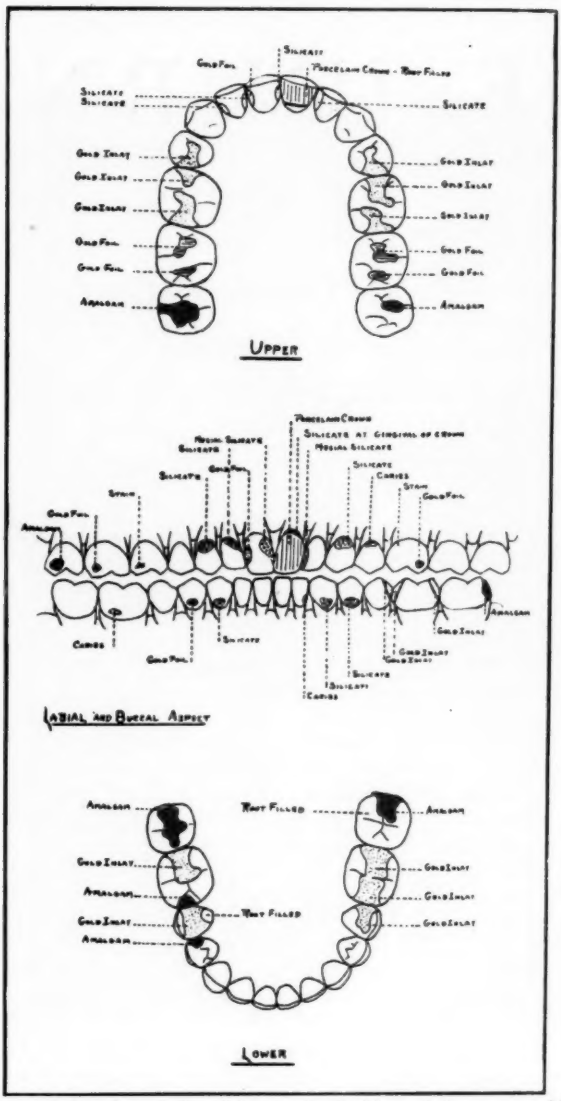

Fig. 1.—Survey of dental work found in mouth of oldest victim, presumably the mother. (Survey made at Harvard Dental School by Harold E. Tingley.)

the head with a 38 caliber automatic pistol.

There were no articles other than a few pearl buttons found in the earth

around or under the skeletons; which indicates that they were laid in their grave without clothing other than their sleeping garments. Two skeletons are identifiable because the oldest, presumably that of the mother, had a large amount of dental work and the older of the two children had orthodontic appliances on both the maxillary and mandibular arches. Because of these two facts, the dental profession may aid in the identification of these victims.

Following are opinions given by dentists after painstaking examination of

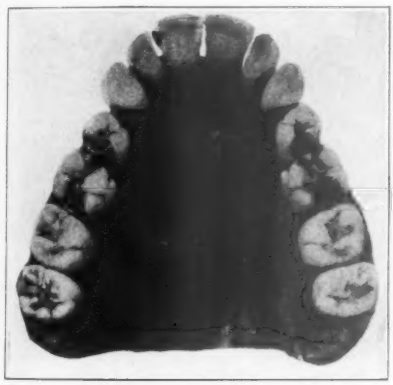

Fig. 2.—Occlusal surfaces of upper teeth of oldest victim. (Compare Fig. 1.)

the dental work found in the mother's mouth:

REPORT BY JOHN W. COOKE

From evidence presented by the dental work present, this person probably had three dentists. The approximate age at death was 40. The oldest dental work present is the foil work, positioned as follows: 1. Buccal, right lower second bicuspid. 2. Mesial, right upper first molar. 3. Buccal, right upper second molar. 4. Occlusal, right upper second molar (2). 5. Buccal, left upper first molar. 6. Occlusal, left upper second molar (2).

The extent of tooth destruction in the places just indicated is moderate, which indicates that the work was done fairly early in life. A safe guess would be at age 15. If we theoretically establish the time of death as 1930, and the age as 40, this work may have been done about 1905. The operator was both conscientious and skilful and may very well have been 50 years of age at that time. It is doubtful that he is still living. Other foil work was undoubtedly done, as there are apparent remnants of foil in upper molars around later inlays.

Shortly after 1905, a change in dentists took place. This may have been caused by the panic of 1907, which may have changed

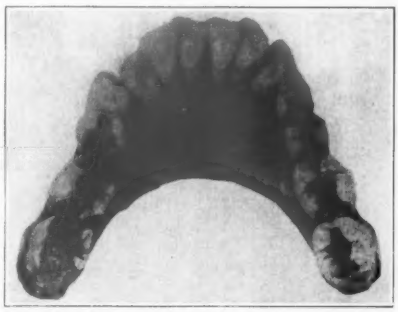

Fig. 3.—Occlusal surfaces of lower teeth of oldest victim. (Compare Fig. 1.)

the circumstances of this person's family. It may have necessitated a change in location, possibly from city to country. This change probably continued for some years and much if not all of the work in the posterior part of the mouth may have been done in amalgam. For reasons that I will give, I think that this period may have continued until approximately 1916-1918.

The patient in 1918 may have been 28 years old and was probably married and had had her first child. Circumstances being possibly financially favorable, and her dental condition not being good, because of the type of dental work since 1905, and possibly the effects of pregnancy, she selects a third dentist, who, in my opinion, did all

of the more modern work, which was not completed. It is probable that, if the time of death was 1930, the patient had not seen her dentist for a period of two years.

From 1918 to 1928, the character of the more modern dental work was very satisfactory, bordering on excellent. It was done by a person accustomed to handling inlay golds, and who probably used a good deal of casting golds of similar if not identical composition. The work was done at intervals during several years. The character of the work suggests the "indirect" method of inlay construction, since none of the teeth so treated show signs of having been shaped or polished by a dentist; which is almost essential to direct inlay work. Work other than the inlay work was carefully executed, suggesting an operator with an eye to the future life of the tooth rather than one striving for a radical and spectacular result.

Fig. 4.—Extra-oral roentgenogram of teeth of oldest victim (left).

It seems probable that the work was done in a large city by a dentist who knew his patients well and who intended to watch them carefully. If the work had been done at varying periods in the country, the color of the casting golds might have shown greater variation.

REPORT BY MAURICE E. PETERS

From the examination of the skulls, I have formed the following opinions:

1. The adult in her early age was cared for by a dentist who was an unusually capable gold foil operator. The mouth contained several well made gold foil fillings which were probably done several years ago.

2. More than one dentist was probably responsible for the dental work done in the mouth. It seems unlikely that a dentist who was capable of doing such good gold foil work would make such poor amalgam restorations.

Fig. 5.—Extra-oral roentgenogram of teeth of oldest victim (right).

3. The gold inlays were probably more recent than the foil fillings and if placed by the same dentist, which is very doubtful, he had, apparently, lost the keen desire or ability to produce perfect margins.

The inlays were, apparently, all made by the indirect method and were probably all made by one dentist. They had prob-

ably been in the mouth from one to five years prior to death.

The jacket crown might well have been made by the same dentist who made the inlays and had probably been in the mouth at least four or five years before death.

The amalgam work was of a different quality from the rest of the work in the mouth and was probably done by still a third dentist at a period between the placing of the foil fillings and the making of the inlays.

The recent work is probably the work of a successful dentist in a city of fair size.

The dentist, I think, does not do orthodontic work and refers his work to a specialist, I should guess that prior to marriage the woman had lived in a large city, had been well-to-do and had visited the dentist frequently. After her marriage, she had either moved to a different vicinity or through changed financial circumstances had either neglected her teeth or gone to a different dentist, who worked more cheaply and not so well.

Ten or twelve years before death, she had returned to a better state of health or a better financial status and had, over a period of a few years, been in the hands of a dentist of good standing.

Fig. 6.—Skull of older child with orthodontic appliance in place.

REPORT FROM THE HARVARD DENTAL SCHOOL BY LEROY M. S. MINER, ARTHUR M. MALONEY AND HAROLD E. TINGLEY

1. Occlusion: There is marked closing of the bite with protrusion of upper anterior teeth; no resulting separation of the teeth; lower incisors striking lingual gingival tissue of maxilla; overjet 7 mm., overlap 5 mm.

2. Missing teeth: Both upper first bicuspids are missing, evidently extracted.

3. Root treated teeth: The upper left central incisor, lower right second bicuspid and lower left second molar showed root fillings.

4. Porcelain crown: Upper left central incisor has a crown of very dense porcelain, the gingival margin of which is quite low (just above the lingual singulum). A probable lingual hypertrophy is due to the bite.

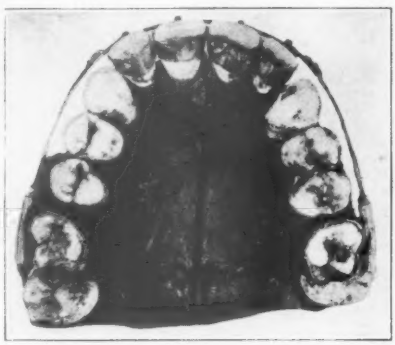

Fig. 7.—Occlusal view of teeth of older child, showing lingual adjustment of bracket bands and curvilinear tubes.

5. Silicates: The anterior silicates resemble Asher's enamel.

6. Amalgams: These fillings, for the most part, are very old.

7. Gold fillings: There are some gold fillings in the posterior teeth and in one central incisor.

8. Inlays: Gold of different hardness was used for the inlays and some inlays were cut into others for retention.

Figure 1 shows a very careful survey of the dental work found in the mouth

of the oldest victim, presumably the mother, made at Harvard Dental School by Harold E. Tingley.

You are requested to make a careful study of this chart, and make comparison with your own records. If the slightest parallelism is evident, it will be well, in an effort at comparison, to visualize this mouth as one having an extremely close bite and prominent maxillary incisors.

The use of a strong magnifying glass will aid in reading the chart.

Figures 2 and 3 show occlusal surfaces of the teeth of the oldest victim. By comparing them with the chart, you

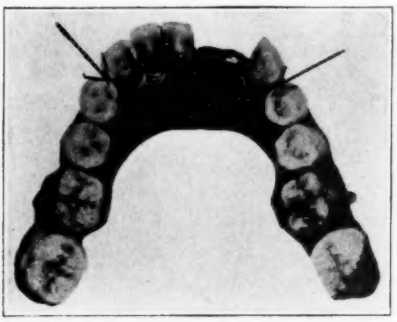

Fig. 8.—Comprehensive view of three piece lingual wire and position and direction of intermaxillary hooks on buccal surfaces of mandibular first molars. The soldered points at the first bicuspid areas are to be noted.

will be able to form a clear picture of this patient's mouth.

Figures 4 and 5 are extra-oral roentgenograms of the oldest victim.

Following is a description of the orthodontic appliances found in the older child's mouth, together with photographs showing the various aspects of these appliances. In your efforts at identification, you are asked to think back to the decade between 1920 and 1930, as it is believed that during this period the major part of the dental work, was done for the mother and that the orthodontic appliances were probably adjusted sometime during the period between 1925 and 1930, with the remote possibility that it may have been adjusted prior to that time.

The older child, the one with the orthodontic appliances in place, was between 12 and 14 years of age, probably about 13. The condition of the teeth was found to be excellent. *They are of exceptionally good quality, showing no*

Fig. 9.—Lingual aspect of molar lock and its construction. (Use of a good magnifying glass will aid in the study of these photographs.)

evidence of caries. The maxillary arch form corresponds very nearly to the Hawley chart 36, the six anterior teeth falling exactly on the line, while the bicuspids and molars are about 2 mm. toward the lingual aspect. Therefore, the maxillary arch might be considered about normal for this type of child, who was probably of slender stature. The second molars were on the point of erupting, the left second molar showing evidence

of some delay. Third molars were in the process of development. Maxillary central incisors measure 0.36 inch in mesiodistal width. The child was being treated for bilateral distoclusion with a slight narrowing of the mandibular arch. The mandibular incisors were somewhat protruded. The mandibular right second molar had erupted to the point where the mesial cusps had just penetrated the overlying tissue. The mandibular left second molar had erupted somewhat farther than the right. The mandibular bicuspids and molars were not in need of rotation, as is very frequently found in children of this age. They have well developed cusps with deep sulci.

Fig. 10.—Extra-oral roentgenograms of child's mouth with appliances in place (left).

Fig. 11.—Extra-oral roentgenograms of child's mouth with appliances in place (right).

The incisal edge of the maxillary left central incisor has a slight chip broken off involving the lingual plate. The operator who adjusted the appliances to this child was a man who used careful technic.

The appliance which is adjusted to the maxillary arch is known as the Angle ribbon arch and is manufactured by the S. S. White Dental Manufacturing Company. It is attached to molar bands cemented on the first molars, to which are soldered curvilinear tubes. The nuts anterior to these tubes are of the sheath variety. The four bands which are cemented to the four maxillary incisors are fitted around the middle third of the incisors. The operator who adjusted these bands had placed a solder reinforcement on the lingual surface of the right lateral and central bands. The left central and lateral bands were not quite so well adjusted on the lingual aspect. The molar bands were made of the gold band material, probably of platinum alloy, with soldered seams on the lingual surfaces. They have the appearance of having been made by what is known as the indirect method. There are a few marks which would indicate that the bands were brought to place by the use of a band driver.

The operator exhibits his careful technic by the fact that the intermaxillary elastic hooks which are placed opposite the mesial third of the maxillary cuspid

have been carefully balled on the ends. Also, this operator has the habit, when pinning his appliance in place, of turning the ends of the lock pins toward the median line; that is, the pins on the right central and lateral incisors turn to the left, while the pins on the left lateral and central incisors turn to the right. The lock pins are of gold alloy. There are no lingual extensions soldered either anteriorly or posteriorly from the maxillary molar bands.

On the mandibular or lower arch is a lingual wire made of 0.036 inch gold platinum wire. The arch is made of three pieces soldered on a line of the interspaces between the cuspids and first bicuspids. The lingual wire is attached to gold platinum bands cemented to the mandibular first molars. On the lingual surfaces of the mandibular first molar, bands are soldered between the mesiolingual cusp and the distolingual cusp half-round tubes. The lingual wire is held in place by a half-round shaft or post soldered to the lingual wire, which fits exactly into the half-round tubes. *The lingual wire has no loops anteriorly from the first molars. This fact narrows down the investigation by excluding all those who use the lingual wire loop in their technic.* The spring locks which are designed to hold the lingual wire in place are soldered to the distal ends of the lingual wire about 1.5 mm. posteriorly from the tubes and are of a smaller gage (0.025 inch). There are intermaxillary hooks soldered to the buccal surfaces of the mandibular molar bands. The one on the right is soldered nearer to the occlusal surface than the one on the left. These hooks are also balled on the distal ends. The bands had probably been in place for some time, as they show wear. They were cemented in place by brown oxyphosphate cement. There are several manufacturers who make this cement.

This child probably experienced difficulty in wearing the intermaxillary elastics because of the fact that when the teeth were in occlusion, the right maxillary molar impinged so closely upon the right mandibular intermaxillary hook that it must have broken the elastic frequently.

The salient points which should help in identification are:

1. The method used by this operator in bending the maxillary arch wire pins toward the median line. This man, being meticulous in his technic, probably always followed this method when using this type of appliance.

2. The slight chip which is broken from the maxillary left central incisor and which would probably show in any plaster model that had been taken prior to the orthodontic work.

3. The operator's evident habit of using a small amount of solder in making the attachment of the curvilinear tubes to the buccal surfaces of the maxillary first molars. He used brown cement in setting his bands. *He used gold platinum three piece lingual wire soldered just anteriorly from the mandibular first bicuspids and without loops anteriorly from the first molars.*

4. The fact that the *lingual wire lock is of the right-angle type, not rounded on the posterior end.* The fact that the operator used a smaller gage wire for the spring in the lock would indicate that his technic in adjusting the appliance after its removal for treatment was not to use this lock as a spring lock, but to force it into place by pressure with an instrument. This observation is only a possibility.

5. The fact that the lock pins were of gold alloy.

6. The fact that the teeth are of exceptionally good quality, showing no evidence of caries.

Orthodontists who may be eliminated from studying their lists of patients are those who, during that period, made use of removable appliances in the treatment of this type of case and those who employed loops or those who soldered the locks anteriorly from the first molars in the lingual arches.

In making your study of the orthodontic appliances, do so with regard to the fact that these appliances were made and adjusted probably between 1925 and 1930. ***You will need to recall your technical methods and habits during that period, and possibly a few years prior to that time.***

Figure 6 shows the skull of the older child with orthodontic appliance in place. It is evident that treatment was near completion.

In visualizing the child as first presented for treatment, it will be necessary to think of the child as from 10 to 12 years of age and not 13 years of age; that is, the model of this child taken before the beginning of treatment would represent a child from 1 to 2 years younger than the one shown in this photograph, with the maxillary anterior teeth somewhat out of alinement.

Figure 7 is an occlusal view, showing lingual adjustment of the bracket bands and the curvilinear tubes.

Figure 8 gives a comprehensive view of the three piece lingual wire and position and direction of the intermaxillary hooks on the buccal surfaces of the mandibular first molar. Note the soldered points at the first bicuspid areas.

Figure 9 shows the lingual aspect of the molar lock and its construction. (The use of a good magnifying glass will aid in the study of these photographs.)

Figures 10 and 11 are extra-oral roentgenograms of the child's mouth with the appliances.

It will not be sufficient merely to satisfy yourself that these appliances were not made by you or in your office, but we would appreciate a communication from you if you have ever met with this type of appliance as patients pass through your hands, with the names of those you know who occasionally or habitually use this type of appliance.

The authorities feel strongly that the identification of these three unfortunate people can best be effected through the efforts of the dental profession.

60 Charlesgate West.

A COMPARISON OF ROENTGEN RAY, TRANSILLUMINATION AND BACTERIOLOGIC EXAMINATIONS OF PULPLESS AND INFECTED TEETH*

By EDWARD H. HATTON, B.L., M.D.; F. JIMINEZ, J. V. LENBERG and WALLIE McMURROUGH, Chicago, Ill.

THE LITERATURE

THE problem of the diagnosis of infection at the apices of teeth is still a perplexing and vital one. The investigations of Rosenow[1] and Haden[2] are widely known. The former has stated repeatedly that bacteria have been recovered from all pulpless teeth that he has examined and that by far the greater proportion of all organisms so recovered are virulent. Haden is a little more conservative, estimating that 46.2 per cent of all pulpless, roentgen-ray negative teeth are infected. Only 17 per cent of the 600 teeth in his group, according to his results, are definitely sterile. Not long ago, Rhoads and Dick[3] offered some statistical information on the bacteriologic examination of roentgen-ray negative pulpless and vital teeth. The figures are based on total counts for comparative interpretation. For vital teeth presumably healthy and roentgen-ray negative, the counts run from 0 (only one case) to 8,800, fourteen teeth being examined. For the twenty-nine roentgen-ray negative pulpless teeth, the figures run from 120 to 11,000,000. Sixteen of these twenty-nine teeth have higher counts than any of the fourteen healthy controls, and they have to do with twelve of eighteen patients. Thirteen of the twenty-nine teeth in this group measured by the control standards may be considered to be without infection. Very high counts, 100,000 or more, were found in only seven teeth of the total of twenty-nine. No statements were made with reference to the roentgen-ray diagnosis except that they were negative, and no reproductions of roentgenograms were shown.

A rather critical study of the reliability of various methods of bacteriologic examination was made by Henry, Sniffen and Doyle.[4] They believe, from their experiments, that examination of teeth, even after so-called aseptic extraction, is a highly unsatisfactory procedure and suggest that the outside of the tooth apex to be examined should be dipped in alcohol and the tooth flamed to remove

*Read before the Section on Therapeutics, Pathology and Research at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 20, 1935.

1. Rosenow, E. C.: Changing Concepts Concerning Oral Sepsis, J.A.D.A., 14:117 (Jan.) 1927; Oral Sepsis in Relationship to Focal Infection and Elective Localization, ibid., 14: 1417 (Aug.) 1927.

2. Haden, R. L.: Survey of Systemic Disturbances Traceable to Infected Teeth, J.A.D.A., 17:2015 (Nov.) 1930; Dental Infection and Systemic Disease, Philadelphia: Lea & Febiger, 1928.

3. Rhoads, P. S., and Dick, G. F.: Roentgenographically Negative Pulpless Teeth as Foci of Infection: Results of Quantitative Cultures, J.A.D.A., 19:1884 (Nov.) 1932.

4. Henry, G. W.; Sniffen, D. A., and Doyle, Mary C. H.: D. Cosmos, 72:1132 (Nov.) 1930.

traces of contamination from mouth fluids. They state that dental roentgenograms give accurate indication of infection in about 75 per cent of both vital and pulpless teeth.

Although the material is not generally pertinent to the subject of this paper, we should like to refer to a recent bacteriologic study of some phases of focal infection by Mela.[5] He isolated organisms from four sources: stomach and duodenal ulcers, oral foci in cases of nephritis, oral foci in cases of arthritis and oral infection (granulomas) in persons otherwise in good health. Rosenow's technic was followed rigidly up to and including injection into rabbits. The incidence of lesions in the bodies of the rabbits was determined both bacteriologically and histologically. Cultures were made from weighed amounts of blood, liver, kidney, spleen, joints and duodenum and the results reported in terms of the number of organisms per gram of tissue cultivated. With respect to specific localization, their data reveal a distinct tendency in the arthritic and nephritic strains toward specific localization and total absence in the other two. Furthermore, with respect to the number of organisms recovered and the extent of the damage found histologically in the animals that were inoculated with the strains recovered from lesions in the mouths of persons in good health, their results are so insignificant as compared to the other strains as to merit attention.

Since none of our experiments concerned attempts to isolate bacteria from the apices of teeth *in situ,* no references are made to the work of Coriell and others having to do with results obtained by this method of study.

One of us (E. H. H.), Skillen and others[6] have studied teeth by histologic methods to determine conditions with reference to infection and the associated roentgen-ray examination. Skillen reported a high degree of agreement between the results obtained by these two methods of examination (over 90 per cent). It has seemed to us that histologic examination is the only reliable means for determining the presence of infection in this region in the final analysis. Unfortunately, it cannot be used except on extracted teeth and therefore has no clinical application.

METHODS AND RESULTS

It has seemed worth while to investigate further the advantages and defects of all methods of accumulating information as to the presence or absence of infection in or around teeth, especially from the clinical point of view. The shortcomings and defects of all the methods at hand have been pointed out frequently and, as has been shown, there is no general agreement as to the degree of reliability of any or of all. In the case of pulpless teeth, there is a distinct tendency toward condemnation even in the absence of any positive indication of infection other than that of routine cultures of the teeth, *ex post facto,* after their extraction in hospital and clinical laboratories. For this and other reasons, a group was set up for this project made up of two dentists and a laboratory bacteriologist. Most of the detail work has been done by these members of this group.

The teeth were studied more or less

5. Mela, B.: Deutsche. Zahn. Mund. u Kieferheilk., 1:65-80 (Sept.) 1934.

6. Hatton, E. H.: Evaluation of the Theory of Focal Infection, J.A.D.A., 21:463 (1934); Possibility of Apical Regeneration After Root-Canal Filling from Histopathologic Point of View, 9:192 (Feb.) 1922; Skillen, W. G.: Pulpless Tooth from Histologic Standpoint, J.A.D.A., 14:500 (March) 1927.

independently clinically, by roentgen rays and by transillumination, and finally bacteriologically. Extraction was carried out carefully, though no extra precautions were taken to insure uncontaminated specimens. After extraction, the whole teeth were wrapped in sterile gauze and carried to the laboratory. Cultures were made by scraping material first from the outside of the apical portion and secondly from the pulp canal of the apical root canal after flaming the tooth. In carrying out the second plan, the tooth was first dipped in alcohol and the alcohol burned off by passing the tooth through a gas flame. The root end was then cut off and material removed from the root canal with a sterile barbed broach. All cultures were first made in glucose-brain broth, and in every case in which positive results were obtained, the growths were transferred to blood agar plates for further study.

The cultures made by scraping the outside of the tooth before flaming were, in every case but one, positive. In a majority of these cultures, several organisms were later identified on blood-agar plates and *Streptococcus viridans* was recovered most frequently. Except in the summary and conclusions, no further attention will be paid to these cultures, and wherever later bacteriologic results are referred to, it will be understood that we are dealing only with the instances wherein we removed the material for culture from the root canals after flaming the tooth.

Although a little more than 100 teeth were studied, of these only forty-five may be offered as suitable for comparison. The first forty-two were defective because of the lack of familiarity of the operator with the method of transillumination. In a number of the succeeding cases, there was no roentgen-ray examination or transillumination.

SUMMARY OF FORTY-FIVE CASES

Roentgen-ray positive, 28; negative, 17.
Transillumination, positive, 29; negative, 16.
Bacteriologically positive, 20; negative, 25.
All three methods in agreement, 17.
Roentgen-ray and bacteriologic examination in agreement, 23.
Transillumination and bacteriologic examination in agreement, 28.
Roentgen-ray positive and bacteriologic examination negative, 13.
Roentgen-ray negative and bacteriologic examination positive, 6.
Transillumination positive, bacteriologic examination negative, 7.
Transillumination negative, bacteriologic examination positive, 9.

Neither the roentgenogram nor the transillumination shadow reveals directly the presence of bacteria. Variations in roentgen-ray penetration are due wholly to changes in the density of bone or to gross changes in the form of the bone. The transillumination shadow would seem to be due to variations in the dispersion of the source of light by the soft tissues as the light passes from one side of the alveolar process to the other. If this is true, it supplies some information as to the condition of the soft tissues, but not of the bone nor of the teeth. The roentgenogram, therefore, supplies information rather exclusively limited to the condition of the hard tissues and transillumination only with that of the soft tissues. It may be suspected that either method of clinical examination has to do with the changes caused by infection only indirectly and that the relationship of either to infection can be ascertained only by a process of deduction. Neither records infection as such, only some of the changes produced by infection in the hard and soft tissues, and diagnosis is a process of interpretation of the significance of these changes.

A high degree of correlation between bacteriologic examination and either of these mechanical aids to diagnosis is

therefore improbable. On the other hand, an agreement of only about 50 per cent is considerably less than that attained by Henry, Sniffen and Doyle, about the same as reported by Haden and materially higher than that implied by the results of Rosenow, Rhoads and Dick. We believe that the degree of actual agreement is nearer to that reported by Henry, Sniffen and Doyle and that the reason for the great discrepancy in the various results is the lack of a sufficiently reliable and sensitive method for making the bacteriologic examination. All of the methods generally used are compromises because of the difficulty of getting ideal material with which to work.

By far the commonest organism recovered was *Streptococcus viridans*. Since this was recovered by both methods of bacteriologic examination, even from the scrapings of the roots of teeth just as they came from the extracting room, it would seem that little confidence should be placed in the results of examination of teeth submitted to hospital and diagnostic laboratories in order to determine whether teeth are infected. While we do not condemn the practice of submitting extracted teeth to clinical laboratories for bacteriologic examination, it does seem to us a very insecure foundation upon which to base either a diagnosis or the preparation of a vaccine.

It is probably true that the relative virulence of the organisms recovered deserves consideration, just the type of consideration that is most difficult of attainment by the average bacteriologist. With respect to this, we should like to refer again to the figures quoted from Mela having to do with the virulence of strains of bacteria recovered from oral lesions of persons in good health as compared with those suffering from arthritis, etc.

Although the degree of agreement with the results of bacteriologic examination is slightly better for transillumination than for roentgen-ray examination, it should not be assumed that the former is a better or more reliable method of examination than the latter. Neither do these results warrant placing great confidence in the results of transillumination. Those who have been using transillumination with various degrees of satisfaction will without doubt derive some comfort from these experiments. We desire to offer no explanation as to what happens in transillumination, nor do we wish to make any recommendations with respect to its use. We believe that our results justify further investigation of the significance of this phenomenon.

The changes revealed by the roentgen rays are thoroughly understood and, as the result of long use, confidence in this method of examination may be said to be securely established. When checked by other methods of examination equally reliable, such as those of anatomic dissection or histologic examination, the degree of correlation is high, being well above 90 per cent. On this account; it does not seem fair to condemn roentgen-ray examination on the basis of the reported discrepancies between the results obtained by bacteriologic methods and by roentgenography.

We are presenting these results in the form of a progress report. We believe that our methods of examination and bacteriologic technic are not at all perfect and that, with further improvement and refinement, more convincing data can be produced. Since transillumination may supply some additional information as to the condition of the soft tissues not depicted in the roentgenograms, this method is deserving of further investigation. As a matter of fact, in our cases, the three methods of examination, on the

basis of agreement of two out of three, there was correlation in thirty-seven out of the forty-five. Each method of clinical examination seems to supplement the other.

SUMMARY

1. The results of cultures of extracted teeth without any treatment after extraction are in substantial agreement with those reported by Rosenow, Rhoads and Dick. On the other hand, cultures made from the root canals of flamed teeth yield results differing widely from those just mentioned and showing a tendency to agree with the data reported by Henry, Sniffen and Doyle and, to a less degree, those reported by Haden. The former indicate no tendency to agree with the results of roentgen-ray examination, while the latter do show such a tendency.

2. As yet, there is no wholly reliable and sufficiently sensitive technic for the examination of extracted teeth by hospital and clinical laboratories as a routine procedure.

3. Bacteriologic examination of the roots of extracted teeth without some type of previous sterilization of the outside of the root is generally positive.

4. The degree of agreement, as far as this study is concerned, between the results of roentgen-ray examination, transillumination and bacteriologic examination is approximately the same for both roentgen-ray examination and transillumination.

FACTORS IN TISSUE REPAIR AND RESISTANCE TO INFECTION*

By ROBERT W. KEETON, M.D., Chicago, Ill.

IT is my purpose to discuss the conditions controlling tissue repair and resistance to invading infections. Growth and repair have constituted a field over which experimental zoologists have waged many bitter battles. Physicians and dentists are daily confronted by this biologic riddle. They must meet its problems, and to do this they must have some sort of practical working basis for the solution of its many manifestations.

It was a source of comfort to me to find that even mathematics is not an absolute science and that a logical imagination was a helpful instrument to apply to its complexities. Hence, if some general rules for guidance through this field of knowledge may be found, even though they be embellished with considerable imagination and tinged with statements that cannot always be substantiated by unequivocal evidence, I feel that discussion will not have been useless.

GROWTH AND REPAIR

Growth Promoting Hormone.—Animal life springs from a single cell, which frequently receives its stimulus to growth from union with another cell. The cells multiply in numbers, differentiate from

*Read before the Section on Medical Relations at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 19, 1935.

one another and finally attain a maximum size, usually designated as "adult size." During this period of expansion, the growth processes are at a maximum. When adult size is reached, they are slowed up. The spontaneous drive ceases. In the adult body, an equilibrium has been reached. Growth is instituted only when the body is damaged. With the replacement of the damaged tissue, the stimulus to growth disappears. These intermittent growth periods are usually spoken of under the term "repair." The adult body remains for varying periods of time in this balance state. Then it enters on a period of decline or "senescence." The stimulus to repair fails to evoke an adequate response and so repair is accomplished with difficulty. Wasting, decay and death supervene.

For growth and likewise for repair, there are three requirements: (1) the structural elements or building stones comprising the amino acids of the protein molecule and lipoid constitutents; (2) a readily available source of energy to condense these into complex structural units, and (3) a catalyst to drive these synthesizing reactions.

After birth, the source of protein and lipoid constituents is the food. Hence, an optimum supply of these substances in the food is a necessity. This relationship of the height of protein to growth is shown in the accompanying table from Proscher.

The rapid growth in the cat, doubling of his body weight in seven days as compared with man, in whom 180 days is required, presents an interesting correlation with the increased proteins in the milk.

It is also well established that to induce satisfactory growth in the child, from 2 to 3 gm. of protein per kilogram of body weight is required. To meet the requirements for repair in the adult, only 1 gm. of protein is needed.

For the synthesis of body structure, which seems to consist largely of protein and lipin, energy is required. This is obtained from the oxidation of carbohydrates primarily and fats secondarily. All of these factors are readily available in the food and present no problems.

The third factor, the catalyst, which prompts the reactions of synthesis, is often present in varying amounts. This

RELATIONSHIP OF PROTEIN CONTENT* OF MILK TO GROWTH

	Time in Which Body Weight of New Born was Doubled	Protein	Ash	Lime	Phosphoric Acid
	Days				
Man	180	1.6	0.2	0.328	0.473
Horse	60	2.0	0.4	1.240	1.310
Cow	47	3.5	0.7	1.600	1.970
Goat	19	4.3	0.8	2.100	3.220
Pig	18	5.9	...	.....	.....
Sheep	10	6.5	0.9	2.720	4.120
Dog	8	7.1	1.3	4.530	4.930
Cat	7	9.5	...	.....	.....

*To 100 parts milk.

catalyst is found in the anterior lobe of the hypophysis and is known as the "growth promoting hormone." If it is present in excess prior to puberty, giantism results. If the excess occurs after puberty, the patient develops acromegaly. This condition has been reproduced experimentally in dogs by Putnam, Benedict and Teel.

If there is a reduced concentration, the individual fails to reach adult size and remains a dwarf. Evidence has been furnished by Evans and his associates that the concentration of this hormone may be increased in senescent rats by transplants of the anterior lobe of the hypophysis. Apparently, then, there is a correlation between the quantity of growth promoting hormone present in experimental animals and the reaction of the body to growth and repair.

By implication, this correlation may be extended to man. Man's life cycle expressed in concentration of this hormone would be bounded by puberty on one hand, and on the other by the menopause in the female and a similar age in the male. We have only to consider the thin parchment-like skin of the aged, the slow recovery from infection and the delayed healing often seen in broken bones to realize that shortage of this hormone may constitute a factor in the delayed repair and poor healing. Its function is, therefore, primarily that of synthesizing protoplasm.

Thyroid Extracts and Thyroxin.—A second important factor in tissue repair is the thyroid hormone. This product, thyroxin, apparently assists the growth promoting hormone of the anterior pituitary. Thus, children with normal growth curves would be presumed to have normal concentrations of both of these hormones present in their bodies, and yet their growth may be definitely accelerated by the addition of a daily dose of desiccated thyroid. This has led to some confusion in the minds of clinicians and these two hormones have been considered as interchangeable. Perhaps this problem can be clarified best by considering the physiologic effects of thyroxin on the adult body.

The energy expended by the body in maintaining itself in a resting state, in which no work is done, is spoken of as the basal metabolism. This energy is used to maintain body heat and to sustain the heart beat, the respiration, the secretion of gastric juice and the urine and other somatic functions. The amount of thyroxin stored in the body ranges between 17 and 20 mg., and it is constantly being consumed in the daily work and replenished by the thyroid gland. In its destruction, it converts some of the potential energy of the carbohydrates and fats into kinetic energy by oxidation. The kinetic energy is now available for maintenance of body functions. Each milligram of thyroxin is capable of developing a definite amount of energy, which can be measured in terms of heat produced. If the body stores of thyroxin are reduced, the kinetic energy will be reduced and so the behavior of the resting machine changes. The heart beats more slowly, the respiration rate falls, the skin becomes cool to the touch, the appearance changes and the temperature falls to a subnormal level. In short, the metabolism decreases. If the body is robbed of all the thyroxin, the energy expenditure drops 40 per cent. Since energy is derived from carbohydrates, fats and deaminized proteins, and its production is controlled by the action of thyroxin, it is evident that thyroxin accelerates growth by furnishing energy to promote the synthesis of body proteins, reactions which are catalyzed by the anterior pituitary hormone. By the same token, thyroxin is necessary for tissue

repair. In its absence, growth slows down and may cease. This is especially true in mammals. On the other hand, thyroxin cannot initiate growth. It is not a catalyst that synthesizes protoplasm.

We find striking illustrations of the validity of this interpretation in the clinical behavior of untreated myxedema cases. Thus, a woman with myxedema (rate −35) was operated on for gall stones. The gallbladder was drained and the wound required four months for healing. A second patient, aged 65, with a metabolic rate of −30, developed a sty on the eye. Hot dressings were continued for seven days with little effect. Administration of thyroid extract caused immediate involution. A third patient developed an infection around the big toe. This showed no signs of healing until desiccated thyroid was administered.

It is perhaps too sweeping a statement to say that repair will not occur in animals who have no thyroid gland nor any thyroxin stored in the body tissues. It is true that the repair processes are so slow that healing is to be considered pathologic.

STUDIES IN TISSUE CULTURES

It would seem that this problem of growth and repair could be simplified by studying the behavior of small pieces of tissue grown *in vitro*. The medium on which the growth is occurring could be altered at will and quantitative observations made of growth rates. In these studies, fibroblasts, a type of cell largely responsible for tissue repair, have been used. Carrel, Harvey and their associates have developed and explored this field. Their results will be summarized briefly as follows:

1. Damage to tissues arises usually from trauma, i.e., abrasions or surgical incisions, on the one hand, or from bacterial abrasions, on the other. Carrel has shown that if two identical wounds are made on the skin of dogs and the edges of the experimental wound are kept apart with dead subcutaneous connective tissue, but the edges of the other are allowed to fall together, the behavior will be quite different. After three weeks, the experimental wound will not be healed. On the other hand, the control will be cicatrized in a normal manner. It is concluded that the tissue juices resulting from this trauma constitute a stimulus initiating repair.

2. The repair response of the body originates in the reticuloendothelial system, a relatively undifferentiated mesenchyme. This system has two components, a relatively fixed group of cells, the endothelial fibroblastic and reticular cells, and a truly wandering group, the monocytes of the blood and tissues, and the histocytes. The first movement of repair is one of mobilization, multiplication of these wandering cells and invasion of the damaged area. This process is spoken of as exudation. If bacteria are present, polymorphonuclear leukocytes (microphages) may be added to the exudative cells.

After a short period, the exudative reaction subsides and a proliferative growth of fibroblasts becomes established. The rate of growth of the proliferating cells may be accelerated, as will be pointed out later.

3. The formative stimulus causing this fibroblastic growth and response is found in great concentration in embryonic tissue juice. It can be manufactured by digestion of pure proteins to the proteose and polypeptid stage, but it is lost if these are digested into amino acids. More recently, gluthathione, one of the polypeptids which yields on hydrolysis glycine, cystine and glutamic acid, has been identified by Baker and by Hammett

as one of the substances for cell multiplication.

4. The polymorphonuclear leukocytes of the blood stream which invade damaged tissues grow well in adult plasma and are able to digest it into proteoses and polypeptids. The supply, therefore, of these polypeptids (formative stimulus) is furnished at first by cell injury and later by leukocytic digestion of blood plasma.

5. Plasma taken from adult and senescent individuals inhibit the fibroblastic growth and response. This inhibition seems to be due primarily to the fats and secondarily to aging changes in the protein.

These studies are most important in defining the factors in the reparative processes. I shall endeavor to apply these to the realm of clinical medicine.

FURTHER CLINICAL CONDITIONS IN WHICH REPAIR PROCESSES ARE SUBNORMAL

Mention has already been made of conditions in which there is a lack of anterior pituitary growth-producing hormone (dwarfs, case of hypopituitarism) and thyroxin (myxedema).

Agranulocytosis.—Of late, we have heard much of this disease. Ulcerations appear, especially in the mouth and throat. There is no reparative tissue reaction developed. The lesion invades rapidly, causing a hard area of induration, redness and necrosis. At times, it is associated with hemorrhage. At no place does a line of demarcation occur. If the blood is examined, there is lowering or absence of the polymorphonuclear leukocytes or granulocytes. The red cells and their hemoglobin content are preserved. The temperature runs high, toxemia is marked and death not infrequently follows quickly. The pathogenesis of this condition lies in the failure of the bone marrow to produce granulocytes. Whether this failure is due to a toxic agent or a poor grade of bone marrow is not important in the present discussion. By reference to the studies in tissue cultures, it can be seen that, with an absence of granulocytes, there is also an absence of digestive enzymes which hydrolyzes the plasma into proteoses and polypeptids, and so there is an absence of the "formative stimulus" which is responsible for the macrophage and fibroblastic response. The primitive mesenchyme is not stimulated. We thus have a plausible explanation for the outstanding symptom of the disease, "loss of inflammatory reaction" or loss of reparative process.

Xanthomatosis and Obesity.—In these cases, there are tumor-like growths of fatty material, largely lipins and cholesterol, and pigment located in the subcutaneous tissues. The blood contains increased quantities of cholesterol. Values up to 600 mg. have been observed. The tumors are supposed to develop from the reticulo-endothelial system, the cells of which become infiltrated with lipoid material. In one such case, ulcerations developed on the feet. For a long time, little or no progress was made in healing. Finally, it was decided to give the patient large quantities of carbohydrate with the hope that, in its oxidation, any unburned fatty products that were accumulating in the tissues would be oxidized. Insulin was administered twice a day to stimulate the appetite. Under such a régime, the pain in the feet was relieved, the wounds, which showed an indolent necrotic surface, began to clear and a very obvious tissue reaction developed. Since then, the patient has made a slow but uneventful recovery. Here again, one may develop an analogy from the tissue culture studies. It was noted that the presence of fat inhibited the repair reaction, the growth of the fibro-

blasts. It seems plausible that the presence of excessive fat in the plasma of patients with xanthomatosis would also inhibit repair of a wound bathed with this plasma. The marked repair response in the wound associated with a drop in the blood cholesterol to a normal value, 180 mg., from 324 mg. would indicate a correlation between the fat and poor healing. In a second case, an injury to the leg resulted in an indolent ulcer, which healed under the same management.

At this point, attention should be called to the high incidence of postoperative hernia in obese patients. In obese patients, the removal of the gallbladder is commonly followed, after six weeks, by a slight separation of the edges of the wound, which grows larger with time. Occasionally, when the retention sutures are removed, at the end of two weeks, little or no healing is found along the edges of the incision. Surgeons have now begun to recognize that it is unwise to operate on the obese except as a matter of emergency. At the University Metabolic Clinic, a larger number of obese patients are undergoing weight reduction in preparation for an operation to repair a postoperative hernia.

Diabetes Mellitus.—It is a matter of common knowledge among the laity that failure of boils and wounds to heal is often associated with the presence of sugar in the urine. Prior to the discovery of insulin, only emergency operations were performed on diabetics. Surgical procedures were not deliberately undertaken. There is still no clear-cut agreement as to the cause of the poor healing in these cases. It has been generally assumed that the excess sugar in the blood and tissue fluids was the offending agent, supposedly disturbing the water balance and interfering with transport of fluids. We constantly see diabetics make excellent recovery, with perfect wound healing despite the fact that the urine is never sugar-free and the blood contains increased quantities of sugar.

Rabinovitch recently studied a group of cases in which wound healing was poor. Many of these patients had elevated blood sugar. The urine of all was sugar free. The poor healing was attributed to the defect in the carbohydrate metabolism, without further attempt at analysis. It should be appreciated that diabetic patients have a defect in fat metabolism which is contingent on the defect in the oxidation of carbohydrates. When the fatty acids are incompletely burned, they have to be neutralized by bases. These ketone bodies may really be etiologic agents in the poor wound healing. Thus, it is known that diabetic patients who acquire tuberculosis do poorly. It has been further demonstrated by Root that the incidence of tuberculosis is rather high in diabetics who have had attacks of acidosis; which would mean diabetics who have had an increased amount of unburned fatty acids in the blood and tissues.

In a case of healed tuberculosis in which diabetes developed and then an activation of the tuberculosis with cavitation, the patient had been suffering from chronic acidosis for from three to four months prior to examination.

In another case of rapid extension of tuberculosis in a diabetic, the tuberculous process swept through the lung, melting it down as the sun rays melt the snow. If one studies these cases, he can readily observe that these patients have a maximum of exudation. There are large numbers of macrophages which have entered the site of the lesions and they in turn are being destroyed and liquefied. The patient seems unable to proceed to the second stage of the reaction proliferation with fibroblast formation. It would seem more logical in the light of present

knowledge to attribute this failure to defects in the fat rather than the carbohydrate metabolism. When the diabetes is controlled through the entire twenty-four hour period, the reaction is better able to proceed to the proliferative stage. Such a control offers the tuberculous diabetic his only chance of living.

Focal Infection.—The dentist has been deluged with studies in the last ten years on the deleterious effect of abscess and infection of the teeth. They have been reputed, correctly or incorrectly, to be the cause of all manner of disease. It is not my purpose to enumerate the diseases due to focal infection, but rather to discuss the mechanism by which such a disease produces its clinical picture. This mechanism, I find, is not clearly understood by doctors who meet it daily.

Arthus found that it was possible by injecting a rabbit repeatedly with horse serum to change the behavior of the body cells. After a latent period, substances can be found in the blood stream which are known as antibodies, and the same or similar substance (sessile antibodies) can be found, remaining attached in the cells. The cells of the rabbit are now said to be sensitized. If a small amount of horse serum is again injected subcutaneously into the ear of such a sensitized rabbit, a pronounced local reaction occurs. This may be one of swelling and edema; it may consist of swelling, edema and ulceration, or it may go on to gangrene. This is known in the literature as the Arthus phenomenon. The violence of the second local reaction depends on the degree of sensitization or the quantity of sessile antibodies present. It should be further emphasized that this is a cellular or local reaction and not one occurring within the blood stream.

Let us consider the case of a patient with rheumatic fever who has a focus in the tooth. This focus, through a period of time, has been liberating into the blood stream varying and repeated doses of bacterial protein. The patient finally becomes sensitized, sessile antibodies having developed in his cells. Then one morning the patient wakes up with a swollen wrist or knee. During the night, a somewhat larger dose of bacterial protein or bacteria has been liberated. It has been carried to blood vessels of the muscles and other peri-articular tissues. An explosion occurs in the sensitized cells; a local reaction of the Arthus type appears, and the patient is said to have rheumatism. This keeps repeating itself, and so the rheumatism is said to creep from joint to joint. The case drags on week after week. When the virulence of the process subsides, the dentist is called in to extract a tooth. Thereafter, the patient may get well. Then the physician, the dentist and the patient are all happy. The theory of focal infection is vindicated.

In the next patient, the process may have gone on a somewhat longer time, the tooth is removed, but the patient does not get well. The theory of focal infection is now considered invalid, and the dentist may begin to be skeptical as to the value of removing such teeth. The difficulty in the second case is due to multiple sensitization in the patient. The normal streptococcic flora of his mouth and throat may be so closely related to those of the tooth that they continue the production of symptoms. Such a patient must now be desensitized by a process similar to that in use for treatment of hayfever. The theory needs only a little extension and understanding.

This same mechanism is involved in iritis. The painful red eye which refuses to heal when various drops are placed in it undergoes a rapid healing after a tonsillectomy or extraction of a tooth. The

recovery from hives, erythema multiforme and similar skin lesions may be accomplished in the same manner.

Procain Dermatitis.—The mechanism of procain dermatitis has been cleared up by the work of Landsteiner. The dentist says that he is sensitive to it and takes precautions to avoid contact with it on the bare skin. This skin reaction is quite obviously another example of a local reaction (Arthus phenomenon). Since the procain was a relatively simple, nonprotein molecule, it was not antigenic. The difficulty arose as to how it could be converted into an antigen. Landsteiner showed that such a drug may form a union with a protein molecule and the protein procain complex enters the cells. Under these conditions, antibodies develop with specificity determined by the procain. Recovery from this disease could be accomplished by desensitization to the protein procain complex, but it is much easier to wear rubber gloves.

VARIATIONS OF THE MAXILLARY SINUS AS SEEN IN THE ROENTGENOGRAM*

By Le ROY M. ENNIS, D.D.S., and OSCAR BATSON, M.D., Philadelphia, Pa.

THE maxillary sinus has been quite comprehensively studied by the anatomist from his point of view and by the rhinologist from his point of view; but, as far as the dentist is concerned, their observations are a veritable maze, many of them having no clinical application of particular value.

There are certain anatomic parts of the sinus which must be adequately understood before an intelligent opinion can be rendered in the numberless cases of suspected disease changes in the upper dental arch. With the prominence given the theory that focal infection is a cause of systemic disease, many valueless and even harmful procedures have been instituted by both the dentist and the physician, each doing a certain amount of groping in the dark.

Clinical observations have been compiled to permit a better evaluation of many of these conditions, and it is possible for the dentist to become a highly valuable factor in spreading more advanced information pertaining to the maxillary sinuses; for he has an intensive knowledge of the relative size, the conformation and the location of the sinus, and the physiologic, anatomic and pathologic conditions pertaining to it and to the contiguous regions and structures.

The surface of a great part of the sinus is formed of the maxilla, which holds the teeth; and the relative possibilities, the relative effect of the presence of the teeth upon the sinus, or vice versa, is significant.

It is hoped that this paper may contribute to a better understanding of our problem by a discussion of the anatomic parts of the sinus from the angle of the roentgenologic examination, designating shadows that may develop on the film and dwelling on those points whereby the

*Read before the Section on Oral Surgery, Radiology and Anesthesia at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 20, 1935.

normal structure may be differentiated from the pathologic.

The maxillary sinus is known to be a cavity of varying dimensions, always present in the maxilla, its extension or enlarging process accompanying the growth of the face. At birth, it exists merely as a slitlike indentation on the outer wall of the nasal fossa; for, at this period of life, the maxilla is made up almost entirely of the alveolar process, the sockets of the unerupted teeth being almost in contact with the orbital plane of the maxilla.

Its presence and the phenomena of its growth are, of course, observed even earlier. Schaeffer[1] indicates that, about the seventh day of fetal life, the maxillary sinus begins to grow from the evagination of the mucous membrane of the floor or lateral wall of the ethmoidal infundibulum, forming a primitive pouch. Sometimes, two such pouches form, their fusion probably explaining the rather rarely met double adult maxillary sinus, each part of which has its independent ostium.

By the end of the first year of life, the maxillary sinus has so developed in width that it reaches below the orbit, although

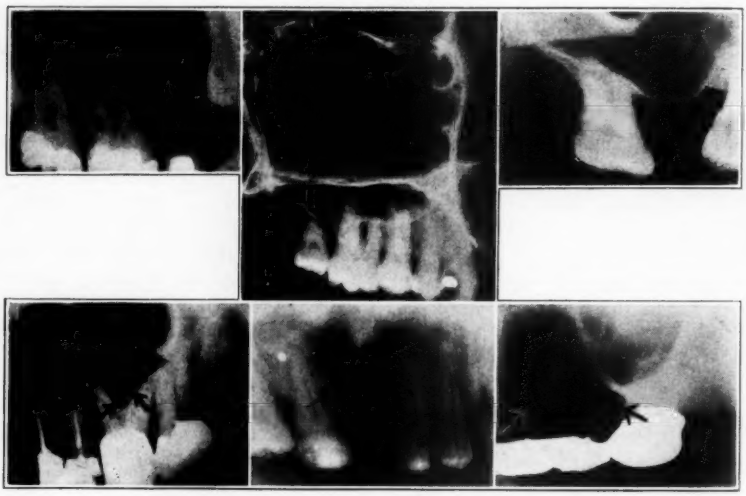

Fig. 1.—Alveolar extension of the maxillary sinus. Above: Center, floor of maxillary sinus at considerable distance below floor of nose. Left, alveolar extension of maxillary sinus, which extends into bony septums between second bicuspid and first molar and between first molar and second molar. Right, alveolar extension of sinus in region of first molar, combined with resorption of alveolus, allowing only thin plate of bone between sinus and oral cavity. Below: Left, sinus extending into bifurcation of roots of first molar, with septum over second bicuspid. Center, loss of first molar, maxillary sinus extending into alveolar process in area formally occupied by first molar. In all probability, the sinus extended into the bifurcation of the first molar before extraction. Right, marked alveolar extension of maxillary sinus, in which there has been little resorption of alveolar process.

1. Schaeffer, J. P.: Nose, Paranasal Sinuses, Philadelphia: P. Blakiston's Son & Co., 1920.

not beyond the position of the infra-orbital canal. By the twentieth month, it has developed further posteriorly to the position of the rudimentary first permanent molar.

This early growth is related in historical and chronologic detail that a better understanding may be had of the later, maturer developments.

In the third and fourth years, there is a very conspicuous growth in width, which progresses increasingly thereafter until, at the seventh year, we note an average width of 18 mm., an average height of 17 mm. and an average length of 27 mm.

With children, seemingly, the growth of the maxillary sinus progresses proportionately with the progress of age and dentition, although, until the teeth erupt and the alveolar process develops, little space avails for this sinus. But the process goes on, developing downward until, about the age of puberty, or about the time practically all permanent teeth save the third molar have erupted, the floor of the sinus is on the level with the floor of the nose.

The largest of the paranasal sinuses, the adult maxillary sinus, resembles in general a three-sided pyramid. It lies laterad from the outer side of the nasal fossa, occupying a greater part of the maxilla. Its walls are of varying thickness.

The lining of the sinus is a delicate vascular mucoperiosteal layer, a ciliated epithelium containing mucous glands, its deeper portion serving as a periosteal covering of the cavity. This lining is continuous with the lining membrane of the middle meatus through the ostium maxillaris.

The median wall or base is directed toward the nasal fossa, the apex of the pyramidal shaped cavity lying at the zygomatic process of the maxilla. The upper or orbital wall is often modeled by the ridge containing the infra-orbital canal. The anterior wall is toward the face and is varyingly impressed by the canine fossa. Although often reduced by the extensions of the sinus into the adjacent alveolar process, the posterior-inferior wall is normally the thicker.

In studying conditions connected with the sinuses, the dentist must have in mind that there is a great variation in size in

Fig. 2.—Palatine extension of maxillary sinus. Center: Sinus extending into palate, to region of first incisor, roentgen rays passing vertically through palate. Left: Palatine extension of sinus; radiolucent shadow of lachrymal canal in lateral wall of nose. Right: Palatine extension of maxillary sinus; radiolucent shadow (passing across palate), which is distortion of lachrymal canal.

different persons, and quite often in the two sides of the face; and also that the sinuses become so modified by local enlargement as to lose the typical pyramidal appearance.

Zuckerkandl[2] discusses the extensions of the maxillary sinus as (1) alveolar, (2) palatine, (3) zygomatic and (4) infra-orbital. To these, because of its great dental significance, we add the tuberosity extension.

As presented by Zuckerkandl, the alveolar extension is produced by the hollowing out of the alveolar process. Occurring usually after the age of puberty, and observed most prominently in the region of the first molar, the sinus often extends into the bifurcation of the roots of the first molar. Roentgenograms made after extraction of the first molar show the sinus extending farther into the alveolar process, sometimes almost to the crest of the alveolar ridge. It is extremely important that this particular extension be recognized as such, for the uninformed may identify it as a cystic area or some other pathologic lesion. (Fig. 1.)

The palatine extension is the designation given the excavation of the floor of the nasal fossa by the extension of the alveolar process between the plates of the hard palate. This would show more in the anterior third of the palate, and may extend over to the median line of the palate, appearing in the roentgenogram as a continuation of the anterior portion of the maxillary sinus. (Fig. 2.)

As first suggested by one of us (L.M.E.), in 1930, it may be differentiated from a cystic area by following the outline of the typical y that develops on the roentgenogram as the line of the inner wall of the sinus reaches the region of the first bicuspid.

For the clear indication and sure interpretation of this, the occlusal film seems to serve the better; and because this palatine extension is less common than the alveolar extension, extreme caution must be used to guard against misinterpretation of this condition.

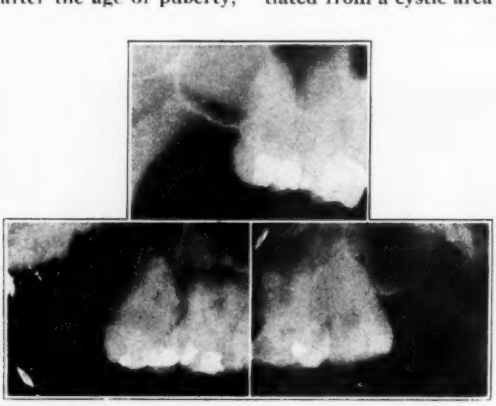

Fig. 3.—Tuberosity extension. Extension of the sinus into the tuberosity of the maxilla posterior to the third molars causes the alveolar plates and posterior wall of the sinus to be very thin.

2. Zuckerkandl: Der Anatomie der Nasenhöle, Leipsic, 1893.

The designation of infra-orbital extension covers the encroachment of the sinus into the frontal process of the maxilla. While seemingly it is of less importance than the other two already mentioned, i.e., the alveolar extension and the palatine extension, the operator must be able to interpret its appearance clearly, for sometimes it forms a typical pocket between the infra-orbital canal and the inner wall of the sinus. Failure to recognize this condition may be serious; for, in postero-anterior views of these sinuses, the pocket may cast a shadow over the nares and the ethmoidal sinus, which, improperly interpreted, may be taken for an abnormal lesion; which might lead to an unjustifiable surgical procedure, with results that may prove dire.

The zygomatic extension has practically no significance to the dentist.

While the posterior-inferior wall of the sinus is usually the thickest, in numerous examinations the sinus is found to extend so far into this wall as a tuberosity extension that thinness not only of the posterior-inferior wall, but also of the supporting structure of the third molar and, sometimes, of the second molar, results. (Fig. 3.)

Recognition of this condition is important, especially when it becomes necessary to extract the teeth in this region. Because of the thinness of the alveolar plates and the posterior wall of the sinus, the plates may fracture and come away with the teeth, a large opening in the alveolar process remaining, with only the mucoperiosteal lining separating the sinus from the oral cavity.

Thus, after the tissues have been restored, there would be practically no alveolar ridge upon which a denture could be constructed. There will remain nothing but a flat plane; but with a thorough understanding of this tuberosity extension, teeth may be removed surgically without great loss of their bony support.

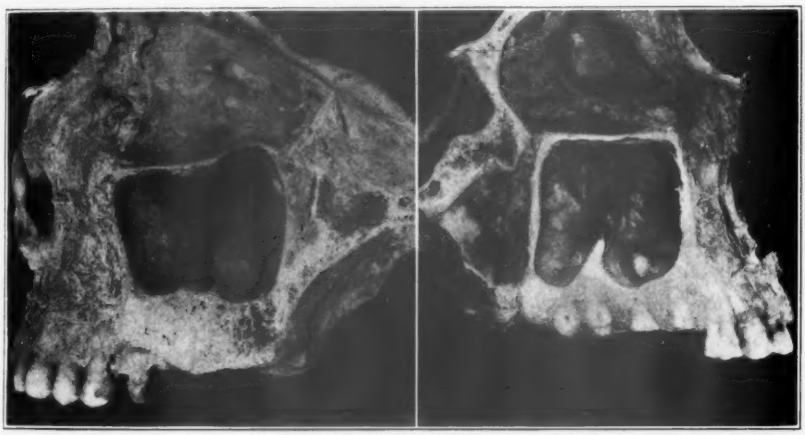

Fig. 4.—Septums of maxillary sinus. Left: Two small ridges on floor of sinus passing up lateral wall and dividing floor of sinus into three compartments. This type of ridge appears in the roentgenograms seen in Figure 5. Right: Rather broad septum extending across floor of sinus shown in Figure 1, below, left.

When it becomes necessary to perform an alveolectomy in an edentulous mouth having such a bulbous tuberosity of the maxilla, it is essential that the presence or absence of any tuberosity extension of the sinus be established; otherwise, the operator may make an opening into the maxillary sinus.

Especially there might be noted cases in which the maxillary sinus seems particularly large, a condition due to hollowing out of the sinus in all directions, creating a condition of thinness of the sinus walls, with extensions markedly developed. It should be obvious that no attempt to operate in the molar or bicuspid regions should be made without a thorough roentgenologic study.

The mere enumeration of these anatomic variations of the maxillary sinus should impress the dentist with the importance of a knowledge of the entire region, a lack of which spells danger.

While not nearly so important from the angle of dentistry as are these enlargements, which govern operative procedure, cases in which less developed or more contracted conditions of the sinus are manifested must not be ignored.

There are many and varied causes of these conditions: imperfect absorption of the cancellated bone on the floor of the sinus; secondary thickening of the sinus walls; unusual depression of the canine fossa; imperfect eruption of the teeth; excessive bulging of the lateral nasal wall, or inadequate aeration of the sinus during growth and development, due, as mentioned by Shea, of Memphis, to a nasal disease in the maxillary ostium.

In the interpretation of roentgenograms, the least of the variations that are manifested in the maxillary sinus must not be overlooked. The differences discovered in even normal sinuses are so great that cases of abnormality charge the operator and the roentgenologist with the responsibility of knowing to the greatest degree the veriest detail of the anatomy of the maxilla and its surrounding structures.

We cannot possibly recognize fully the variations in the anatomic appearance of the maxillary sinus without having clearly in mind the relationship between the floor of the sinus and the floor of the nasal fossa.

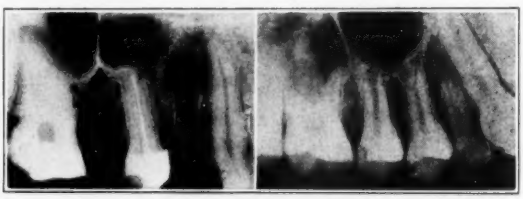

Fig. 5.—Type of ridge referred to in Figure 4.

While, about the age of puberty, the floor of the sinus is on the level with the floor of the nasal fossa, from that period on, the floor of the sinus descends below that of the nasal fossa. The degree of descent depends on the degree of the hollowing out or pneumatization of the alveolar process of the maxilla.

Sir Arthur Keith[3] reports a series of measurements showing that, in cases of contracted palate, the nasal cavities are not more shallow than usual, and that

3. Keith, Arthur: Growth of Jaws, Normal and Abnormal, in Health and Disease, Dental Board of the United Kingdom.

their floors, formed by the hard palate, are at normal levels, the alveolar bone, for some reason, growing and expanding more in a vertical direction and less in a horizontal direction.

From another series of measurements, Keith concludes that one feature of these sections is seen in the downward expansion of the maxillary sinuses, which, in the normal palate, descend to the level of the palatal plane, but which, in the contracted palate, descend 10 mm. below this plane; so that, in the abnormal palate, the direction of the growth of the alveolar bone and the expansion of the maxillary sinuses progress more nearly vertically than in the normal palate.

It is also observed that the degree of arching of the hard palate, affecting, as it does, the floor of the nose, has some bearing on the relationship of the floor of the sinus to the floor of the nasal fossa.

With resorption of the alveolar process following the loss of teeth in later years, recession of the maxillary sinus occurs. The greater the resorption, of

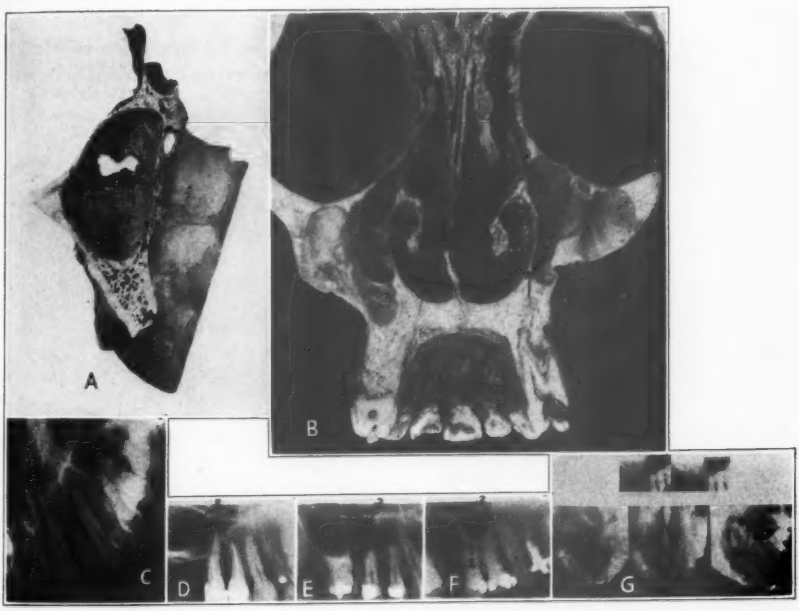

Fig. 6.—Typical y formation. *A*, cross-section of maxilla about level of floor of nose; showing lateral wall of nose separating nasal fossa from maxillary sinus so that it comes forward. The anterior wall of the sinus can be seen passing outward, and the lateral wall of the nasal fossa continuing forward; forming a typical y, containing cancellated bone. *B*, section showing portion of lateral wall of nasal fossa (indicated by arrows) appearing in roentgenogram as seen in *E*. *C*, occlusal film, showing typical y outlining maxillary sinus and nasal fossa. *D*, intra-oral (small) film, showing the typical y. *E*, lateral wall of nose running anteroposteriorly and forming y in cuspid region. *F*, septum in sinus over second bicuspid with formation of typical y in cuspid region. *G*, typical y formation on right side; while, on left, sinus and part of nasal fossa have been obliterated by large dentigerous cyst, y formation being thus eliminated.

course, the greater the recession; so that when the alveolar process is completely resorbed, the floor of the maxillary sinus is again on a level with the floor of the nasal fossa, about as it appeared at the age of puberty.

It is evident that the relationship of the maxillary sinus to the teeth cannot be constant, because of variations in the size of the sinuses and of the teeth. The cancellated bone between the roots of the teeth and the floor of the sinuses varies in thickness in different persons; and if the cancellated bone is thin, the roots of the teeth form elevations on the floor of the sinus which are a factor in forming recesses.

Fig. 7.—Cyst over second incisor. The lachrymal canals may be seen on either side, in the lateral wall of the nose, appearing as radiolucent circular areas. A distortion of the canal may be seen in Figure 2, right.

The extension of the sinus into the alveolar process results in the direct communication between the roots of the teeth and the mucous membrane of the sinus. This intimate relation between teeth and sinuses must ever be in mind. With a clear mental picture of the sinus, it becomes evident that the exact number of teeth bearing a direct relationship must be inconstant, depending primarily on the size of the sinus.

Occasionally, cuspids are found in direct relationship, although not nearly so often as are the bicuspids. In fact, the three molars are in intimate, vital relationship with the floor of the sinus in the vast majority of cases observed.

Roentgenologists frequently make the important discovery that the walls of the maxillary sinus are uneven. This may not be evidence of a pathologic lesion. The irregularities or uneven spots consist of ridges or crescentic projections of varying sizes and proportions, which occasionally are replaced or followed by septums. The smaller ridges need not be considered of consequence, but the large ones that tend to form pockets and recesses of different depths within the cavity may not be disregarded.

Fig. 8.—Floor of maxillary sinus. The lachrymal canal can also be seen in the lateral wall of the nose.

The septums divide the sinus into two cavities, and, forming at various angles and heights, warn the operator that he must be wary in interpreting roentgeno-

grams of this region and when treating conditions subsequently. (Fig. 4.)

Theory suggests that the larger septums might be a development from the two primary pouches, often discovered in the early stages of life, the intervening wall disappearing in part to leave the large septums seen among adults.

The chief explanation of these osseous projections on the wall of the sinus is probably the unequal resorption of the bone during the development of the sinus, the latter occurring along the line of least resistance.

Very often, blood vessels are found within the septums. This may indicate that, as the sinus developed and extended, the bone containing these vessels offered more resistance to the process of pneumatization.

Older practitioners are convinced that a correct diagnosis of oral conditions requires both a clinical and a roentgenologic examination. Experience has demonstrated this fact. Ability to interpret reactions to a clinical examination is necessary to scientific work and, even to a greater degree, ability to interpret the lines and shadows that are revealed in the roentgenogram.

Without a comprehensive knowledge of the anatomic structure under examination, disease conditions cannot be recognized. There is no "near" in the lexicon of the dentist. To him, an absolute knowledge of anatomy is a basic requirement; and in nothing more surely than in diagnosis is a little learning a dangerous thing.

Unfamiliarity with the anatomic structure of the maxilla, resulting in failure to recognize minute details of the maxillary sinus and its anatomic variations, has been the cause of irremedial errors.

Thousands of cases must be examined and studied before these variations can be recognized. They may be classified only after the slightest distinctions among these variations can be detected; for, like the historian, the dentist needs a wide knowledge of the past before he can interpret the present.

One of the most nearly invariable of the anatomic structures of the maxilla is the inner wall of the maxillary sinus, which, as we know, is the lateral wall of the nasal fossa. Very irregular, it is formed anteriorly by the nasal process of the maxilla, with the posterior margin of which the lachrymal bone articulates.

Fig. 9.—Nutrient canals. Left: Case in which alveolar branch of internal maxillary artery passes forward to region of ala of nose. Center: Nutrient canals extending over apical region of cuspid. Right: Nutrient canals in maxilla between first and second incisors.

The middle portion of the wall is formed by the lateral mass of the ethmoid bone above the inner surface of the body of the maxilla, the inferior turbinate bone at the lower end and, posteriorly, the vertical plate of the palate bone and internal pterygoid plate.

This inner wall separates the nasal fossa from the sinus; and the floor of the nasal fossa is found extending much farther anteriorly than the floor of the sinus. As the inner wall of the nasal fossa extends forward, the anterior wall of the maxillary sinus swings outward laterally, then posteriorly, as the outer wall of the maxillary sinus.

Where the anterior wall of the sinus swings away from the outer wall of the nose, a typical y is formed. In the crotch of this y is cancellated bone, which supports the bicuspids, cuspids and incisors.

This y, therefore, becomes the most differential diagnostic landmark in the interpretation of intra-oral roentgenograms. The smaller intra-oral films often show the inner wall of the maxillary sinus extending forward as a radiopaque line over the molars and bicuspids; and this y formation may be observed as the line reaches approximately the region of the first bicuspid.

When radiolucent areas here create doubt as to whether a normal or a pathologic sinus is present, and the typical y cannot be detected, we should resort to the occlusal film; for, with this film, a general view can be obtained of the en-

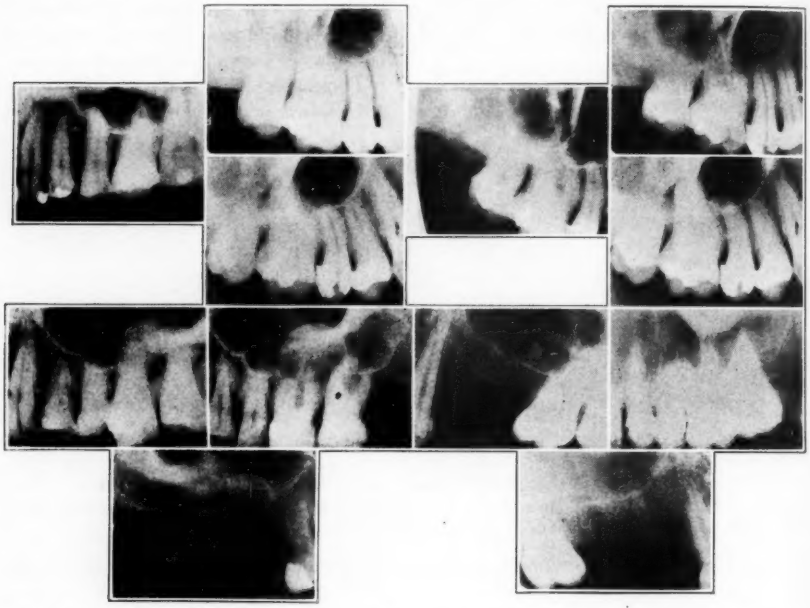

Fig. 10.—Nutrient canals of sinus, over molars and bicuspids. Above, they appear as a plexus over the bicuspids. Below, there is a large canal running forward, also an infected cyst over the first molar.

tire region and thus it will be possible to trace the inner wall of the sinus forward, noting the y formation where the floor of the nasal fossa extends anteriorly to the floor of the maxillary sinus. (Fig. 6.)

Once these structures are definitely located, determination of the presence of pathologic conditions is facilitated. In the inner wall of the sinus, the lachrymal canal is usually seen as a radiolucent area, which has been interpreted frequently as the posterior palatine foramen or as a pathologic area. (Fig. 7.)

For examination of the floor of the maxillary sinus, the occlusal film seems best. With the patient in the chair, and the plane of occlusion parallel with the room floor, the film is placed in the mouth parallel with the plane of occlusion, the long axis of the film anteroposteriorly. The film is carried laterally until its inner border is on a line with the sagittal plane of the head, and the outer border distends the cheek.

This brings the maxillary sinus directly above the film. The tube is posed to direct the rays parallel with the sagittal plane and the tube is then shifted laterally until it is over the region of the infra-orbital foramen.

The vertical angle of the tube should be adjusted to between 75 and 80 degrees, and exposure made. (Fig. 8.) For patients having decidedly receding foreheads, the vertical angle of the tube may be set at approximately 85 degrees.

To interpret roentgenograms of the molar and bicuspid area involving the sinus demands also a knowledge of the blood supply and the nerve supply of the sinuses and teeth in that region.

Traveling practically the same path are the internal maxillary artery and the maxillary branch of the trigeminal nerve, which supply the maxillary teeth and the mucoperiosteal lining of the sinus. The alveolar branch of the internal maxillary artery and the posterior superior dental branch of the trigeminal nerve descend on the tuberosity of the maxilla, where it breaks up into a plexus.

Branches of both artery and nerve penetrate through small foramina in the bone, supplying the molars and bicuspids and the mucous membrane of the sinus. They occur in the outer wall of the sinus in a groove, or, more commonly, in a rather large bony canal, which appears in the roentgenogram as a radiolucent line running anteroposteriorly through the sinus. In some cases, this line extends forward with its terminal branches in the nasal fossa near the ala of the nose. (Fig. 9.)

The infra-orbital artery starts with the alveolar artery, passes through the sphenomaxillary fossa and the sphenomaxillary foramen, and traverses the infra-orbital groove and canal with the infra-orbital nerve.

The infra-orbital nerve gives off two branches, the middle and the anterior superior dental nerves, while the infra-orbital artery gives off the anterior dental artery. The latter, along with the anterior and middle superior dental nerves, passes down the anterior wall of the sinus and supplies the cuspids and incisors and the mucous membrane of the sinus.

The function of these nerves and arteries is to furnish sensation and supply nutriment. They follow no definite straight path, but intertwine and bridge across from one canal to another in the bony structure.

The canals will be observed as radiolucent lines in the walls of the sinus. They are sometimes in direct communication with the apices of the teeth, forming over the apical region rather well-defined areas; which should be kept in mind by the roentgenologist. Too often have these areas been mistaken as indicative of

pathologic conditions. (Fig. 10.) Because these canals are numerous, and because the ability to know and specify exactly which one, or which branch of any one, is revealed in the roentgenogram is at times found difficult, if not impossible, we employ for all a term that is comprehensive and sufficiently explanatory of their functions, speaking of them as nutrient canals.

ESCAPING THE COMMONPLACE IN FULL DENTURE CONSTRUCTION*

By VICTOR H. SEARS, D.D.S., New York City

PSYCHOLOGISTS tell us that the more often we repeat an act in a certain way, the easier it is to do it that way again. Habits are helps to the nervous system, but economizing on mental exertion is hardly an advantage in the making of artificial dentures, as there is no danger of brain-fag in this particular field: quite the opposite. More frequent stimulation of the brain enhances the enjoyment of our work, as well as insures greater satisfaction on the part of the patient.

From Maine to Mexico, in downstair showcase windows, we see stereotyped sample plates which cry aloud their falsity. In observation of people on the street and in daily contacts, we sense an assault on good taste, beauty and naturalness, and many of these misfits stare at us from faces which would otherwise be without serious handicap. Nor do all of these factory made commonplace plates come from offices which display their samples to the public. Far too many are delivered by ethical dentists who might well put more of themselves into their handiwork, render a superior service and get more enjoyment out of this branch of dentistry.

How shall we escape the commonplace? Merely resolving to do so is a step in the right direction. Then we must do the essentially individual operations ourselves, instead of entrusting them to technicians. Even if we rely on laboratories to execute that part of the work which is done away from the chair, we can still check the general design at the trying in stage, and make any necessary alterations before the case is carried to completion. In nearly every phase of denture construction, we are able either to adopt an ordinary, commonplace technic or to develop a nicety and even elegance of execution which adds zest to the work. Let us consider a few of the most important aspects in order to learn where we may best direct our efforts toward refinement.

In the field of esthetics, it will be appreciated that realistic results are to be achieved only by giving individual consideration to each face. No one type of procedure is sufficient to cover the requirements of all patients. Even a beautiful and natural arrangement of teeth would become monotonous if used exclusively for all patients. Naturalness demands individuality.

When the patient comes to us before an extraction, his teeth present a pattern which can be followed in part as to size, form, color and arrangement, to the ex-

*Read before the Section on Full Dentures at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 21, 1935.

tent indicated by good taste. The individual characteristics to which the patient and his associates are accustomed should be at least partly preserved in the restoration. When this is judiciously done, denture work is definitely lifted out of the commonplace.

The only accurate way to follow the individual pattern is to make the required preextraction records. While it is possible to achieve the desired artistic results after the patient has for a time remained toothless, it is better to render a service of superior excellence by the use of a transparent matrix and immediate restoration. Some dentists and many patients do not know of this possibility, but experience has demonstrated that patients in general consider it to be a service above the commonplace. Many a patient refuses to have his teeth removed until he is assured that he need not go toothless, and some have been known to leave their regular dentists, though reluctantly, in order to secure the services of one who practices immediate restoration.

In the matter of size of teeth, the commonplace thing to do is to accept sets of the comparative sizes decided on by the tooth manufacturer. The comparative size is sometimes of more importance than the over-all size in producing the effect of individuality and naturalness. One or both upper lateral incisors may be reduced in size, or they may be chosen of a wider mold, according to the effect desired. Nature introduces a wide variety of effects with upper lateral incisors and we can do likewise.

Tooth form is a moot question, but a study of pleasing natural dentures will disclose two facts that are not incorporated in the rule-of-thumb systems of tooth selection: (1) no matter what the outline of the patient's face, the extremely square, tapering or ovoid attract attention because they border on the freakish; and (2) no arrangement can be artistic unless the individual teeth are themselves pleasing.

Even after the teeth appropriate for the case have been selected, they should never be arranged until the visible portions have been altered in form as nature would have altered them, this alteration to be made according to their relative positions and according to the supposed length of time that they have been in use in these positions. Long ago, G. V. Black called attention to the fact that the combined proximal surfaces of a set of teeth normally wear down to the extent of half the width of a central incisor at about middle life. To imitate this wear, it is always necessary to grind the proximal surfaces of artificial teeth if they are to be arranged in proximal contact with each other. This grinding cannot be done until it is known what the arrangement of the teeth is to be, for which reason it cannot be incorporated in the form of the tooth as made at the factory. The same observation holds true of the incisal edge, which cannot be properly ground except with relation to the opposing incisal edge.

As with size and form, so with color: the commonplace thing to do is to accept all twenty-eight teeth as originally assembled by the manufacturer and stocked by the dealer. When artificial dentures are to be made for high-school girls and boys, the sameness of color and shade in the entire row of teeth is not so serious, but, as the years go on, changes occur, so that, in middle life, there are often decided differences between the individual teeth, differences which we should imitate if we would raise our compositions above the commonplace.

Without recourse to staining, it is possible to produce pleasing effects by selecting teeth of different manufacturers. It might be thought that the forms of

teeth made in different factories would be too divergent to be placed side-by-side in the same row, but this is not necessarily true. As a matter of fact, the resultant slight asymmetry often enhances the appearance. Since the grinding of the proximal and incisal portions of the teeth already referred to and the contouring of the gum line may be made to minimize or magnify the symmetry of forms, we have a large measure of control in the matter even with a given set of teeth. The chief advantage in selecting teeth of different manufacture is the slight difference in color and shade, and more especially the difference in the color distribution in the tooth itself. This matter of color distribution in the individual tooth can be well controlled by means of staining, but the general effect can be approached through a selection of teeth as manufactured.

While in size, color and form we are permitted a certain amount of latitude, in arrangement there are countless acceptable possibilities. It must be appreciated that with all these possibilities there are arrangements which should be avoided: mere irregularity is not necessarily naturalness. There seems to be something about placing teeth on articulated casts in the laboratory that makes them fall into characteristic poses which Nature seldom imitates. The characteristic arrangement is typified by the showcase samples. Perhaps the simplest way of escaping this commonplace is to make a collection of casts from pleasing natural dentures, and keep these casts before us in order to counteract the influence of the stereotyped pattern. Irregularities may be slight or marked, but instead of being haphazard, they should be characteristic of Nature's effects, and, for this purpose, there is no better pattern than natural teeth. This applies not only to approximating teeth but also to the relation of opposing teeth to each other and includes the phase of overbite, especially the horizontal overbite, also referred to as overjet.

Not only the arrangement of the teeth, but also facial fulness must be considered. The commonplace plate is made with a uniform buccal and labial band gingivally of the teeth, and this fact often proclaims the presence of prosthesis even before the wearer opens the mouth. The careful molding of this buccal and labial gum can bring about facial effects that are gratifying to the person who wears the restoration as well as the one who made it. A thickening of the gum over the cuspids and upper bicuspids often produces a pleasing result by restoring the loss of fulness due to resorption of the ridges.

In matters of size, form, color and arrangement of the facial surfaces of teeth, we may well study and follow Nature at her best. When it comes to the occlusal surfaces of posterior teeth, the method leads us astray. Strangely enough, while we have not followed Nature closely enough in form and arrangement of the anterior teeth, we have followed her too closely as regards the posterior ones.

Why must we ignore Nature's pattern for the posterior teeth? Mainly because the function of posterior teeth is mechanical and the edentulous jaw presents a set of mechanical conditions entirely different from the conditions associated with multirooted teeth firmly held in bony sockets. Nature has thus far not evolved any forms to rest upon smooth and slippery ridges, and man is left to his own devices in meeting this abnormal condition. So-called anatomic teeth are commonplace in full denture construction; in fact, much too common. This is not the place to enlarge on the virtues of nonanatomic teeth, but it is proper to call attention to the fact that the arti-

ficial denture which we visualize as being distinctive and superior in design must, in order to achieve outstanding results, embody correct mechanical principles. This whole subject of mechanical principles in denture construction is of the greatest importance, but as it has been dealt with elsewhere,[1] it will be omitted here.

With the teeth themselves and the general denture design lifted above the commonplace, the next consideration might logically be the material on which the teeth are set. Much of the prejudice against artificial dentures on the part of the public is due to the unpleasant appearance of vulcanite. We may argue concerning the virtue of vulcanite among ourselves and with our patients, but the material will always remain commonplace since the advent of the phenol resins. New denture base materials have done much to raise the public estimate of denture service.

As with base materials, so too with other materials and devices there has been a notable improvement within recent years, so much so that it is now possible to construct dentures with a mastery scarcely envisioned before these advances were made. Superior materials, better tooth form and scientific equipment have made possible more exact technics and finer restorations, much to the gratification of those who have availed themselves of these advances.

Finally, there is the much neglected but highly important phase of denture service, which has long languished in the realm of the commonplace. This might, for want of a more apt expression, be called the "psychologic phase." Apparently, but few men have visioned the opportunities in this field. Of course there is little occasion for enthusiasm for the commonplace plate, on the part of either the patient or the dentist, but when once the dentist has sufficiently escaped the commonplace to arouse his own enthusiasm, he is in the frame of mind to stimulate in the patient a high regard for his creation, in which have been incorporated the contributions of biology, chemistry, art and engineering.

Failure to implant in the patient's mind some appreciation of the extent of the problem, with the several sciences needed for its satisfactory solution, reflects on the judgment of the man who renders the service. Here is an opportunity to accomplish three purposes at once: stimulate pride and satisfaction on the part of the patient, raise the regard for dental science on the part of the public and increase the demand for superior service, which means, by inference, our service.

If the public can be made to see romance in radio, travel, cosmetics and even breakfast foods, surely we can put just a little glamor into artificial dentures. So much depends on the way a matter is treated—on the "psychology of presentation," if you please, that a part of our services should always include the kind of presentation which will lift artificial dentures out of the sphere of the commonplace. If we know that our work embodies in large measure the most advanced conceptions in the field, we should, within the bounds of ethics and propriety, make this known. If we do this with elegance and conviction, credit will accrue to the dental profession.

200 West Fifty-Ninth Street.

1. Sears, V. H.: Some Fundamental Factors in Tooth Articulation, J. D. Res., 8:339 (June) 1928; Factors Insuring Full Denture Stability, Bull. Florida D. Soc., April, 1929; Some Fundamentals of Full Denture Construction, Proc. Pennsylvania Soc., 1928; Arranging Teeth on Full Dentures, Proc. Am. Ass'n D. Schools, 1929; Full Denture Procedure, New York: Macmillan Company, 1929; Making Anterior Teeth, D. Survey, 11:36 (June) 1935.

MALIGNANT DISEASES OF THE MOUTH*

By FREDERICK A. FIGI, M.D., Rochester, Minn.

COMPLETE dental examination should include due consideration of the soft tissues of the mouth. A number of systemic diseases can at times be recognized from their characteristic oral manifestations, and these changes should be familiar to the dentist as well as to the physician. Of equal or even greater importance is the recognition of premalignant and early malignant lesions occurring in the mouth. Many of these may be found during the course of dental examination, while they are still symptomless, and even before they have attracted the attention of the patient. Since the prognosis in such conditions is directly dependent on their early recognition and proper treatment, the importance of the rôle of the dentist in this connection can scarcely be overemphasized.

Malignant diseases of the mouth are best considered in groups according to the situation in which they develop, for those growths which arise in a given situation tend to conform to a certain histologic type and degree of activity. Their response to therapeutic measures is likewise similar. Certain generalizations which hold true for the entire group will be reviewed first.

Malignant tumors of the mouth are not uncommon, accounting for approximately 30 per cent of deaths attributable to cancer. They may occur at any period of life, but are much more frequently encountered after the age of 40 years, tending to increase proportionately with advancing years. Since relatively few people live beyond the eighth decade of life, the majority of oral cancers are encountered in the three or four decades preceding this period. Males are more frequently affected than females in the proportion of about 8 or 10 to 1. Concerning cancers in certain situations, notably the lower lip, the disproportion is even greater than this. The lower lip is the most frequent site of origin of malignant growths of the mouth. Cancer develops in this situation between three and four times as commonly as it does on the tongue, and more than five times as often as in the remainder of the oral mucous membrane.

By far the most common malignant lesions of the mouth are the squamous cell epitheliomas. The adenocarcinomas of mixed tumor type, the various forms of sarcoma and the adamantinomas occur much less frequently. Lymphosarcomas rarely occur in the mouth, but are commonly found in the pharynx. Adamantinomas make up a relatively small percentage of the entire group of tumors. Squamous cell epitheliomas vary greatly in their activity or degree of malignancy, ranging from very inactive papillary growths to fulminating, sarcoma-like neoplasms. According to Broders' classification, these are graded from one to four according to their activity as evi-

*From the Section on Laryngology, Oral and Plastic Surgery, The Mayo Clinic.

*Read before the Section on Oral Surgery, Radiology and Anesthesia at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 21, 1935.

denced by cellular differentiation and formation of keratin. This grading by microscopic examination has, with few exceptions, corresponded strikingly with the clinical course of the disease. It has a very practical application and marks a distinct advance in the management of cases. While the grade or activity of the lesion is not necessarily a criterion of its radiosensitivity, it is of decided value in determining the type of treatment advisable in a given case, and in gaging the prognosis.

Although the etiology of cancer is still unknown, certain features of malignant lesions of the mouth are at least suggestive in this regard. As is well known, dental sepsis, which is often extreme, is commonly associated with these lesions. Carcinoma of the mouth afflicts some edentulous persons, but with comparative infrequency; and when it occurs, it is almost always of a low grade of malignancy. The development of such lesions adjacently to carious teeth and ill-fitting dentures, where there obviously has been long continued irritation, has been observed repeatedly. The vastly greater frequency of the disease among males than among females is striking, in view of the fact that chronic irritation is much more often present in the mouths of men. The heavy use of tobacco and alcohol still remains more nearly universal among men than among women. Syphilis very commonly produces oral lesions which are frequently associated with epithelioma of the mouth, particularly of the tongue. In from 40 to 50 per cent of cases in which cancer originates in the tongue, the two conditions may be coexistent. Cancer of the lower lip is often preceded, for a considerable period, by an inflammatory lesion or other benign process. Epitheliomas inside the mouth commonly originate in areas of leukoplakia, particularly of syphilitic and papillary types, and chronic thrush may be a forerunner of epithelioma. The importance of heredity in the development of cancer is difficult to evaluate. Occurrence of the disease in more than one member of a family is not unusual. Fraser mentioned three brothers, living under different conditions, in all of whose mouths epithelioma developed within a period of two years. The possible relationship of the use of tobacco to the development of oral carcinoma has been upheld by many writers, and denied by a few. In our experience at The Mayo Clinic, patients who have had epithelioma of the oral cavity frequently have been heavy smokers. A number of times, I have observed the portion of the inner surface of the cheek, against which a patient had for years carried a quid of tobacco, covered with a thickened, leukoplakial lining, and, in several instances, epitheliomatous change was taking place in this area.

The symptoms of cancer of the mouth vary greatly in severity and in the time of their appearance. On the basis of the situation and the amount of infection present, a small early lesion may produce very severe pain; whereas, an extensive, well advanced growth may cause comparatively little discomfort. As a rule, the patient first becomes conscious of the tumor in the mouth, and shortly after this, experiences stinging or aching pain, or a burning sensation in this area, coming on spontaneously or with eating. The discomfort may, at times, precede discovery of the oral lesion. Not infrequently, especially in cases in which active, malignant growths are situated well back on the tongue, or in the floor of the mouth, the presence of a metastatic mass in the neck, noticed by the patient as a painless lump, may be the first intimation of trouble. Cancerous growths in the mouth vary greatly in appearance,

but they are sufficiently characteristic to permit of clinical recognition in a high percentage of cases. They may present themselves as papillary, smooth, glistening, nodular, elevated or ulcerated lesions. As a rule, there is definite induration of the base, and the tumor may be almost cartilaginous in its consistency. Prominent blood vessels usually stand out on the free surface and margins of the growth. There may be distinct tenderness on palpation. Ulceration usually takes place early. As it progresses, the pain increases, becoming continuous, and the foul, fetid odor characteristic of oral malignancy is noted. Along with this, there is increased secretion of mucus, which is attributable to local pain and irritation, together with progressive dysphagia. Unfortunately, cancer of the mouth does not long remain localized to the situation where it arises. Not only does it tend to grow out into the tissues immediately adjacent, by direct invasion, but extension into the regional lymphatic structures is prone to occur rather early in the course of the disease. The rapidity and extent of spread vary with the activity, vascularity and situation of the growth, the severity of trauma to which it may be subjected, and the degree of inflammatory reaction and infection present. Locally, the lesion most commonly extends by direct contiguity; whereas, distant extension takes place principally through the lymphatic channels. Extension along nerve sheaths and by direct invasion of bood vessels, with formation of malignant emboli, is much less frequent.

Considerable difficulty in diagnosis is likely to be encountered if treatment has been given recently, because of the acute inflammatory reaction present and the change in appearance of the growth. Early diagnosis is essential if treatment is to be effective, and every effort should be directed toward this end. Whenever gross findings do not permit of positive recognition, the physician need not hesitate to remove a small portion of the tumor for microscopic study, provided he is prepared to carry out immediately any indicated therapy. Recently given treatment often will interfere seriously even with microscopic diagnosis of these lesions.

A number of benign conditions must be distinguished from oral carcinoma. Among the most important of these are the primary sore of syphilis and the gumma of tertiary syphilis. The presence of simple chronic inflammatory ulcers, tuberculosis and blastomycosis must be considered. At the clinic, we have encountered a number of cases in which primary actinomycosis of the tongue has been mistaken for cancer. Hypertrophic areas in the buccal folds attributable to the presence of ill-fitting dentures and infected angiomas are likewise confusing, and observation for from a week to ten days, or even longer, may be necessary for differential diagnosis. One of the most troublesome problems is presented when syphilis and carcinoma coexist, particularly in the tongue; which is not unusual. Frequently, antisyphilitic measures, instituted in such cases because of positive results of serologic tests, will be followed by marked improvement for a time. This early, favorable response often results in the treatment's being continued in spite of further activity of the lesion, and the malignant growth may actually become hopelessly inoperable before the true nature of the lesion is recognized.

For the sake of convenience, and more accurate statement of facts, malignant tumors of the mouth will be considered in greater detail in groups, according to the situation in which they originate.

LESIONS OF THE LIPS

With few exceptions, labial growths

are squamous cell epitheliomas, and the great majority of them develop on the vermilion border of the lower lip. Adenocarcinoma of mixed tumor type occurs rarely in this situation. Basal cell epithelioma at times develops on the cutaneous surface of the lips, especially the upper, and secondarily involves the mucous membrane. Almost all of the patients who have cancer of the lower lip are men, as has been said, only about 1 per cent being women. Although several times, at the clinic, we have encountered cancer of the lower lip in examining a patient who was in the second decade of life and one patient was a boy only 13 years of age, by far the majority of sufferers are past middle age. More than three fourths of them are between 40 and 70 years of age. The average age of a group of 942 patients who had cancer of the lower lip and who were studied in the clinic recently was 54.3 years. The growths are usually single, but may be multiple. In the series of cases just referred to, more than one separate and distinct epithelioma was present in more than 5 per cent of the cases. The cancers commonly originate in simple ulcers, fissures, scars, areas of leukoplakia, keratotic areas and in other benign lesions, although some of them are undoubtedly malignant from their inception. The majority of cancers of the lip are of low grade or moderate activity. More than three fourths are of malignancy graded 1 or 2; approximately an eighth are rather highly malignant, and a small percentage are fulminating in type. Their duration at the time the patient comes under observation may range up to several years in spite of the prominent situation of the lesion. A little less than half of those examined in the clinic had received active treatment previously. This fact is of considerable importance, for the response to treatment is less favorable in cases in which there are recurring lesions and metastasis is more likely to occur.

The growths may range from a few millimeters to 5 or 6 cm. in diameter, and may involve only a small portion of the lower lip or may infiltrate the entire lower lip and chin, and a portion of the cheeks and upper lip as well. At times, there is firm attachment to, and erosion of, the mandible, and there may be direct extension through the mental foramen and along the inferior dental canal. Metastasis into the regional lymphatic structures may also have taken place, and the involved nodes may be fixed to the mandible or to the deep structures of the neck.

It should be borne in mind that a thickened or ulcerated lesion, present for more than a few weeks on the lower lip of a man who has passed 40 years of age, will give evidence of malignant change in a high percentage of cases. It is accordingly inexcusable to treat such a lesion without first making every effort to establish a diagnosis. The common practice of applying silver nitrate or other caustic substance, radium, roentgen rays or the actual cautery to such areas often leads to trouble later. In the absence of a diagnosis, such treatment is usually incomplete, and if the lesion is malignant, stimulation of the growth, with increased possibility of metastasis, often results. If the area on the lip has a slightly indurated border, to one who is of sufficiently wide experience, the diagnosis may be evident on clinical examination only. In approximately half of the cases, only microscopic examination will permit of accurate diagnosis. Such lesions can be excised readily under local anesthesia, without noticeable deformity; and, after microscopic study, treatment of the lymphatic structures can be carried out, if indicated. If the growth is so large or

so situated as to render complete excision inadvisable, there should be no hesitancy in removing a portion for biopsy.

In the clinic, epitheliomas of the lip are removed surgically, unless there is definite contraindication to operation. The risk associated with removal of such growths, together with the regional lymphatic structures, has been found to be so slight that comparatively few contraindications exist. Even though the lesion is extensive, if it is of a low grade of malignancy, and if there is no attachment to the mandible, immediate plastic reconstruction of the lip is permissible. After removal of the entire lower lip, sufficient tissue can be brought in from the cheeks to restore the lost parts satisfactorily, as regards both function and appearance. If the growth is active and involves the cheeks, or if it is attached to the mandible, wide excision with the cautery knife, or destruction by surgical diathermy, leaving the wound wide open, is advisable. Thorough cauterization of the surface of the mandible over the area of attachment is necessary in such cases. Plastic reconstruction of the lip is deferred until the patient has been free from evidence of trouble for at least from nine months to a year, depending on the extent and activity of the growth. It may then be effected by means of a lined flap from the forehead, a triangular flap from the upper lip or a tube flap from the thorax. Removal of the submental and submaxillary lymph nodes on either side is carried out in treatment of all surgical lesions of the lip. This is usually done at an operation subsequent to the one at which the primary growth is removed. If excision by cautery has been necessary, dissection of the nodes must, as a rule, be deferred for about three weeks. This may be done before the operation on the lip. If involvement of the nodes is obvious on clinical examination, the operation on the nodes usually precedes treatment of the primary growth.

Results.—In the group of 942 cases of cancer of the lip already mentioned, 390 of the patients had been treated previously. In 17 per cent of this group, metastasis developed, and, in 68 per cent, the patients remained well for five years or more. Of the 552 cases in which previous treatment had not been given, in only 4.5 per cent did lymphatic extension develop, and 80 per cent were well at the end of five years.

LESIONS OF THE CHEEKS

Malignant growths which originate on the inner surface of the cheeks are, with few exceptions, squamous cell epitheliomas. Adenocarcinomas also are occasionally encountered in this situation. Squamous cell epitheliomas are similar in clinical behavior and in degree of malignancy to cancers of the lower lip, although the former tend to be slightly more active than the latter. They may originate on any portion of the buccal surface, but are more likely to develop on a line opposite the occlusal surfaces of the teeth, where there is greatest trauma. The rate of growth varies decidedly, as does that of lesions of the lips. The amount of trauma and irritation to which growths of the cheeks are subjected by the teeth or by other agents frequently will determine their rate of progression. Increased clinical activity that is attributable to acute infection and inflammation is frequently seen, without a corresponding increase in histologic activity of the lesion. Lesions which originate in the commissure, between the upper and lower alveoli, often metastasize early because of the trauma produced by mastication. Epitheliomas of the cheek which are not controlled promptly extend to and invade the jaws. Perforation of the cheek also occurs.

The treatment of this group of malignant growths is much the same as of cancer elsewhere within the mouth. When well localized, the lesions may be excised sharply, or with the cutting cautery, with or without suturing of the wound. More frequently, the wound is cauterized and allowed to granulate. With more extensive growths, and when there is involvement of the mandible or maxilla, wide electrocoagulation, supplemented with implantation of radium or radon points, if deemed advisable, is highly preferable and offers a better prognosis. The indications for treatment of the regional lymphatic structures are the same as they are in the case of cancer of the lower lip. Unless the lesion in the cheek has been treated previously or has been acutely inflamed, removal of the lymph nodes on one side of the neck only is necessary. Otherwise, extension into the lymphatic channels on the side opposite the lesion is not likely to occur. Neoplasms of the cheek most commonly metastasize into the cervical region, on the side of involvement. If the lesion in the cheek is extensive, a varying degree of ankylosis is likely to follow its removal, because scarring may obliterate the buccal folds and bind together the upper and lower alveolar process. Sacrifice of the full thickness of the cheek, with resultant perforation, is unavoidable when the growth is attached to or extends through the overlying skin. Closure of such an opening should be delayed for from six months to a year, the time depending on the extent and activity of the growth.

LESIONS OF THE TONGUE AND FLOOR OF THE MOUTH

Generally speaking, the malignant lesions of the tongue and floor of the mouth are the most formidable of all those which occur within the oral cavity. As a group, they are more highly malignant than those which arise on the lips, cheek or alveolar processes, and accordingly are prone to metastasize more promptly. The extreme vascularity of the tongue, and its rich lymphatic supply, are important factors in this regard. Radium supplementing surgical measures has definitely improved the prognosis in this group of cases, but further improvement probably will result only through early recognition and proper treatment of premalignant lesions and early cancerous growths.

The more common premalignant lesions in this situation include leukoplakia, especially the syphilitic and papillary types, chronic thrush, fissures, inflammatory ulcers and gumma. Areas of thickening developing in areas of syphilitic leukoplakia must always be viewed with suspicion and should be removed. Papillary leukoplakia is a potentially malignant process and should be treated as such. Lesions of the types named in this paragraph frequently are discovered by the dentist in the course of routine examination, early and effective treatment thereby being permitted.

The most common malignant tumor of the body of the tongue is the squamous cell epithelioma. Hemangio-endotheliomas and adenocarcinomas of mixed tumor type occasionally are encountered; also lymphosarcomas. The last type of growth is much more frequent on the base of the tongue. Approximately 90 per cent of the victims of cancer of the tongue are males. Most of the patients are between 45 and 60 years of age, although the condition may occur considerably earlier in life.

In the diagnosis of malignant tumors of the tongue, gummas, thickened areas of leukoplakia, benign papillary lesions, infected cysts, fibromas, solitary tuberculomas, actinomycosis and blastomycosis must be considered. Infected angiomas, especially lymphangiomas, at times

strongly simulate malignant neoplasms in this situation. Enlarged circumvallate papillae and the normal collections of lymphoid tissue at the juncture of the glossal margin and anterior tonsillar pillar frequently have been mistaken for carcinomas. Geographic plaques about the margins and dorsum of the tongue likewise have led to confusion. Biopsy should be carried out promptly when a definite diagnosis cannot be established otherwise.

From the standpoint of prognosis, the most favorable site of involvement is the tip of the tongue, but only a comparatively small group of malignant lesions occur in this situation. Many are situated on, or near, the lateral borders; as might be anticipated, since this region is likely to be subjected to greatest trauma. Involvement of the ventral aspect of the tongue, and of the floor of the mouth, renders the prognosis less satisfactory because of the tendency for rapid local extension and metastasis. Lesions involving the base of the tongue are, as a rule, more highly malignant than those which lie more anteriorly, and they are more difficult to treat because of their inaccessibility and indefinite extent. Carcinoma of the tongue, if allowed to progress without treatment, usually will produce death in approximately a year. Of a group of 162 patients who had carcinoma of the tongue and who were treated in The Mayo Clinic, 156 were traced and 37.2 per cent of these were living five years or more after operation. Recurrences are much more prone to occur in the lymphatic structures than locally. About 70 per cent of recurrent growths develop in the former situation, according to reports by different observers.

The treatment advisable in a given case will depend on the extent, activity and situation of the growth. Well localized tumors on the anterior portion of the tongue may be excised sharply, or with the cutting cautery, particularly if they are not highly malignant. Those situated further posteriorly, as well as those on the ventral aspect, and involving the floor of the mouth, are more satisfactorily destroyed by diathermy and implantation of radium into the coagulated portion. Lesions too extensive for surgical removal should be treated with implanted radium. The use of gold radon points is most satisfactory in this group of cases and frequently affords surprising results. Removal of the regional lymphatic structures should be carried out in surgical cases. The nodes most frequently involved are the one anterior to the internal jugular vein, below the submaxillary group of nodes, and another in the deep cervical group, just posterior to the submaxillary group. These are frequently involved even though not palpable.

LESIONS OF THE JAWS AND PALATE

The malignant tumors of the jaws and palate include epitheliomas, adenocarcinomas of mixed tumor type, adamantinomas and the various forms of sarcoma. Epitheliomas are by far the most common. These, and the sarcomas, may spring primarily from the alveolar processes, or, in the case of the maxilla, they may arise within the antrum, and may invade the superior maxilla secondarily. About the mouth, the mixed tumors most commonly develop in the palate, and the adamantinomas in the mandible. Generally speaking, carcinomas of the jaws are of low grade or of moderate activity and do not, as a rule, metastasize until they extend to involve the adjacent soft tissues of the cheeks, lips or floor of the mouth. Highly malignant, sarcoma-like epitheliomas graded 4 according to the scale of Broders do at times develop on the alveolar process, but not usually. Melano-epitheliomas of the mouth are

rare forms of malignant tumor seen in this situation. They usually arise from the palate, and, like cutaneous tumors of this type, are highly malignant. They may be almost coal black. Several such tumors have been seen in The Mayo Clinic. One encountered recently, in a man 73 years of age, covered most of one side of the hard palate and perforated the palate and alveolus to involve the lower part of the antrum. A pedunculated portion extended well back over the soft palate. Its color varied from a dirty gray to almost black, and dark pigmented streaks extended widely out into the remainder of the palate and cheeks, well beyond the apparent limits of the growth. A specimen for biopsy, removed from the more deeply pigmented portion of the tumor, was coal black and resembled the material from an old hematoma.

The diagnosis of carcinoma of the jaw usually can be made readily from the clinical examination alone, by one who has had appreciable experience with such tumors. Unless there has been recent treatment or trauma, biopsy is not likely to be necessary. It is advisable to take a specimen for biopsy in all cases, before instituting treatment, as a matter of record and to avoid possible confusion. Failure to do so frequently will lead to serious difficulty. Within the past year, there have come under my observation two cases of carcinoma of the mandible in which curettement and local applications of caustic had been carried out for several months. One of the patients had a pathologic fracture and the other was rapidly approaching this condition. Both tumors were bordering on inoperability. In neither case had biopsy been carried out or the true nature of the condition been suspected, in spite of the fact that the lesions were obviously progressing and the patients were suffering intense pain.

Epitheliomas of the jaws are better treated by surgical diathermy or the actual cautery than by resection. In the low grade lesions, surgical measures are relied on almost entirely. In highly malignant growths, irradiation is always used to supplement surgical procedures. Sarcomas of the jaws may arise either from the bone itself or from the soft tissues investing it. The more common tumors are accordingly the osteogenic and fibrous forms. These tumors are usually more highly malignant than the carcinomas which develop about the jaws, and they are more difficult to control. Fortunately, they are also much less frequently encountered. Although there is rapid local growth, ulceration does not occur as early as in epithelial tumors. Extensive metastasis may take place early in the course of the disease. The diagnosis of sarcoma of the jaw may be strongly suggested by the rapid growth and the presence of the smooth, nonulcerated, vascular tumor mass, but in view of the infrequency of such tumors as compared with carcinomas, a positive diagnosis scarcely would be justified in the majority of cases without biopsy. Only in cases of osteogenic sarcoma is the roentgenogram sufficiently characteristic to be diagnostic. Irradiation is the treatment of choice in this group of tumors, although the response to treatment varies greatly.

Adenocarcinoma of mixed tumor type may originate in either the hard or the soft palate or in the pharyngeal walls. These neoplasms differ from all the other malignant tumors originating in the soft tissues of the mouth in that they are encapsulated, grow very slowly and, as a rule, do not metastasize until late in the course of the disease. Certain authors prefer to classify them with the benign tumors, but there appears to be little justification for this, for once they have

broken through their capsules, either spontaneously or after trauma, they may infiltrate the surrounding tissues and metastasize quite as actively and widely as malignant lesions of other types. Clinically, they are firm, smooth or slightly nodular, discrete, somewhat elongated, rounded masses covered by normal mucous membrane. The tumor may not be of uniform consistency throughout. Cystic portions often are present. As a rule, they do not ulcerate spontaneously. Occurring on the hard palate, they produce by pressure absorption a smooth concavity in the bone and may perforate the palate. They are usually easily recognized on clinical examination, and, with careful dissection, can be removed with the capsule intact, in which event the prognosis is good. If they are incompletely removed, they recur, grow more rapidly and may metastasize.

The adamantinomas or adamantine epitheliomas are multilocular cystic tumors belonging to the group of cystic odontomas. Although they occur most frequently in the jaws, they may also develop at the base of the skull in connection with the pituitary gland and even elsewhere in the body. Occurring in the jaws, they are much more common in the mandible than in the maxilla, usually being found in the region of the angle, adjacent to the third molar. They apparently originate from certain cells of the enamel organ, from which their name is derived. The tumor occurs chiefly in adults between the ages of 20 and 40 years, although it has been observed during the first decade and as late as the seventh. It is seen more often in females than in males. It is commonly situated deep in the body of the mandible. The tumors vary greatly in size on primary examination, at times being only 2 or 3 cm. in diameter and again being the size of a grapefruit or even larger. They are partly cellular and partly cystic, the different parts being of varying size and separated by bony trabeculae, so that on palpation they often present an irregularly honeycombed surface which is highly suggestive from a diagnostic standpoint. The roentgenogram, for the same reasons, is sufficiently characteristic to permit of a positive diagnosis in a high percentage of cases. In rare instances, a tumor of this sort presents a single large cystic cavity. The neoplasms are mildly malignant, and of about the same grade of malignancy as the basal cell epitheliomas. Although metastasis is unusual, it does occur in rare instances. Death is not infrequently caused by direct invasion of the skull by these tumors.

The tendency among surgeons in the past has been to deal entirely too conservatively with these tumors. In recent years, there has been a marked swing back toward the radical treatment of some years ago, and it is to be anticipated that fewer recurrences of these growths will be encountered in the future. Electrocoagulation in our hands has proved most effective in dealing with tumors of this group.

A DENTIGEROUS CYST CONTAINING THIRTY-THREE SMALL TEETH

By P. CHUNG, G.D.S., and J. L. BOOTS, D.D.S., F.A.C.D., Seoul, Korea

History.—A Korean, aged 25, came to the hospital dental clinic complaining of difficulty in enunciation and in keeping his mouth clean owing to the presence of a tooth out of line of the dental arch. The patient had not been to a dentist before. His parents and brothers were living, and the family history was negative.

Fig. 1.—Permanent cuspid and thirty-three separate bodies of cyst.

Preliminary Examination.—His mouth was in very good condition, with no caries, and teeth and gums normal, except for a slight abrasion, a small amount of salivary calculus and irregular dentition in the area of the upper left cuspid. The deciduous cuspid was in place and firm. The permanent cuspid had erupted buccally between the second bicuspid and the first molar. There was no pain or swelling, nor any other abnormality, except gingival inflammation around the cuspid from food débris lying between it and the buccal surfaces of the adjacent teeth. There was no indication of the presence of a cyst. The very slight lack of symmetry in the two sides of the face seemed due entirely to the projection of the cuspid.

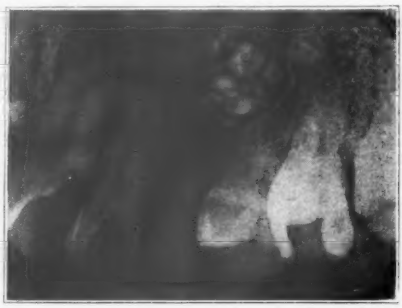

Fig. 2.—Upper left cuspid area before operation.

Roentgen-Ray Examination.—The area around the cuspid was found to be normal, but the cuspid area above the deciduous tooth was occupied by a cyst containing several small radiopaque bodies.

Operation.—Surgical removal was advised, and, under procaine infiltration anesthesia, a gum flap was made, and the buccal bone plate removed with bur and chisel, the fibrous lining of the cyst being

exposed. The bone plate seemed normal in density and thickness. Careful and complete curettement disclosed thirty-three small separate teeth and enamel grains, of

Fig. 3.—Upper left cuspid area after operation.

which about thirteen were distinguishable to the naked eye as complete teeth, consisting of crown and root. One consisted of two teeth fused together, the largest have the general form of a lower bicuspid. Some were decidedly malformed. The smallest seemed to be grains of enamel. The permanent cuspid was removed at the same time.

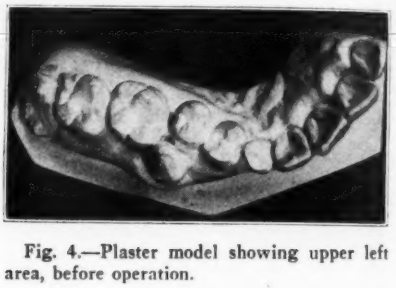

Fig. 4.—Plaster model showing upper left area, before operation.

Outcome.—Recovery was uneventful. Fortunately for the patient, the cyst was found and operated on before radical bone destruction had taken place. The vitality of the adjacent teeth was not destroyed and the deciduous cuspid remains in place.

Severance Union Medical College.

RELATION OF ENDOCRINE DISORDERS TO DENTAL DISEASE*

By JAMES H. HUTTON, M.D., Chicago, Ill.

THE baby, to free himself from the evil influence of a poorly functioning endocrine system, should carefully select several generations of ancestors who are free from endocrine defects. It is quite likely that endocrinopathies and the tooth anomalies they lead to, or are associated with, obey the laws of heredity.

If the baby arrived in this world free from endocrine defects, the orthodontists would lose from one-third to one-half their clients. Endocrinopathies are very numerous and are associated with a great many abnormalities that the dentist is called on to care for and correct as far as this can be accomplished. It would make his road easier if he recognized that many pathologic conditions of the mouth are due to endocrine dyscrasias. Correction of the latter would tend to make some of his work not only easier but also more satisfactory, both to himself and to the patient.

*Read before the Section on Medical Relations at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 20, 1935.

The teeth, like the eyes, often give local expression to some underlying constitutional defect. Dentists might well employ a practice sometimes followed by physicians. When we are unable to locate the cause of the patient's disability by our own examinations, we send him to the dentist. Unfortunately, some men at times send the patient with instructions to have certain teeth extracted, with the further admonition that if the dentist, who knows the patient and his teeth, refuses to follow these orders, the patient shall consult another dentist, who either has less independence of thought or lacks the courage of his convictions and will separate the patient from some good teeth merely because a physician has been unable to locate the cause of his trouble. When the dentist is puzzled as to the cause of certain disturbances in the mouth or their failure to yield to his treatment, he might get considerable assistance by sending the patient for a careful endocrine examination. To point out the indications by which the dentist may judge a possible need for endocrine treatment is my purpose here.

The newest developments in endocrinology indicate that the hormones exert important influences on the teeth and consequently every dentist should familiarize himself with the indications of hormonic divagation from the normal. The dentist cannot treat these conditions, but he can make an effort to see that the patient obtains adequate treatment for them. Thus will his own work be made easier and more satisfactory, both to himself and to his patient.

Looking at the problem from the physician's, not the dentist's standpoint, good teeth may be judged by their size, both absolute and relative, their quality and their placement. That is, good teeth are of a size commensurate with the individual's growth as a whole and are normally related to each other in this respect. They are of adequate hardness and durability, do not show early decay and breakage and last fairly well through a lifetime. They are in normal positions in the jaws, neither widely spaced, nor crowded and irregular. Other important characteristics of good teeth are gums of good quality and normally proportioned jaws, with proper occlusion.

To each of these gages of dental perfection, one or another of the endocrine glands makes the determining contribution. Differentiation of the tooth buds is a distinctly thyroid duty, as are also their development, growth and eventual eruption. The quality of the teeth (assuming a proper diet as a source of raw materials) depends largely on the thyroid and parathyroids. Their absolute size is a phase of pituitary growth hormone activity, which also relates them to the size of the individual as a whole. Their relations to each other seem to be influenced by the thyroid and some not-too-well understood manifestation of the sex hormones—a matter of clinical observation rather than of laboratory demonstration. Their proper spacing depends on the normal supply and synchronization of influences arising in the thyroid and pituitary and exerted on the development and growth of the oral bony structures. The condition of the gums is —again, a matter of clinical observation —at least partly due to thyroid influence, reflecting in turn the tone of the endocrines as a system.

It is not my purpose to review the whole field of endocrinology in this brief discussion. For the sake of clarity, it may be well to explain briefly our present understanding of the functions of the endocrine glands that we have mentioned and their interrelations, before passing to the detailed application to the dentist's problems.

The thyroid, as the first gland to exert its influence on the teeth, may be described as producing the hormone that promotes cell activity. It is responsible for the cell's carrying out its natural destiny or purpose. In the embryo and the fetus, and in the infant, this is largely the process known as differentiation; that is, formation of the requisite organs from the basic tissues. It will be readily obvious why dental anomalies arise in cases of hypothyroidism. The teeth are not properly formed in the first place; or some are missing or present unevenness and irregularities of development. This activity is reduced in later life in proportion to the maintenance of cell and consequently organic function, and its disorders are reflected in the sluggishness of myxedema in its various forms. It must be kept in mind, too, that this thyroid influence expends itself on every single individual cell in the body.

The pituitary supplies a growth hormone, a sex hormone and other stimulating principles affecting the thyroid, suprarenals and probably the parathyroids. In addition, it is the source of the stimulus for the secretion of milk and of a factor which acts in cooperation with insulin for the maintenance of carbohydrate metabolism. We are interested in only the first two mentioned. The gonads, of course, expend their hormonic influence largely in the sexual zone, but there is also a not well understood factor which acts in antagonism to the pituitary hormone. The last is the basis for the slowing down of growth as puberty occurs. It is manifested largely in the bone growth and is related to our present special interest in the fact that jaw bone growth may be affected. If it does not appear properly, we find what is called the asthenic type of individual, tall, thin, narrow-chested, small-chinned and frequently with poor teeth.

The parathyroids control the metabolism of calcium. Their function seems to concern mostly the maintenance of the blood calcium level. They mobilize calcium from its storage places in teeth and bones at need. Deposition of calcium, on the other hand, seems to depend mostly on a proper supply and on the activity of vitamin D. The state known as hypoparathyroidism is characterized by a low level of blood calcium, usually accompanied by the peculiar type of spasms or spastic seizures called tetany. Hyperparathyroidism is marked with a high level of blood calcium, with teeth and bones so stripped of it as to be much less visible in a roentgen-ray picture, and consequently liable to spontaneous fractures (a factor, perhaps, in many difficult dental extractions), giant cell tumors, stones in kidneys and ureters and other symptoms.

THE THYROID

The thyroid's influence begins early in intra-uterine life and continues until the patient has lost all of his teeth. The evil effects of hypothyroidism are most evident during the developmental years, up to the time of the eruption of the permanent teeth. The mother who is a victim of hypothyroidism gains more than the normal 20 pounds during pregnancy. The baby born of such a mother is likely to be overweight. It is slow in walking, in talking and in getting its teeth. The teeth are not only slow in erupting, but they appear in the wrong order and are irregularly placed. Marinus[1] believes the teeth are irregular in size because of this abnormal time and order of eruption. The cuspids may be distinctly undersized and appear in anomalous posi-

1. Marinus, C. J.: Observations Regarding Dental Development of Children with Endocrine Disturbances, Internat. J. Orthodon., 2:229-241 (March) 1934.

tions, or be entirely missing. The cusps of the first molars may be entirely ununited, standing out in the gum tissue as separate points. He says that, in less severe disturbances, there is enamel deficiency between the cusps, which causes early decay of the teeth. Certainly, the teeth are of poor quality. They are soft and are subject to caries and early decay. The dentist is likely to find that his appliances do not serve the purpose for which they were intended. He fails to get the results that he has a right to expect from the skill that he puts into his work.

Engelbach[2] was of the opinion that the orthodontic phase of juvenile endocrinopathies was less important than the infantile. He believed that if dental defects due to thyroid deficiency were corrected in infancy, there would be relatively few abnormalities of the second dentition. It was his opinion also that normality of the permanent teeth depends largely on the normal eruption, growth and loss of the deciduous teeth. It was the opinion of Marinus[1] that a third of the patients seen by the orthodontist were victims of thyroid deficiency. It was his opinion that thyroid therapy is only mildly helpful because the defect occurs during the development of the teeth within the jaw tissue. He said that patients whom he saw at as late as 6 years of age have shown under thyroid treatment the development of a very excellent second dentition. Patients seen at 8 years of age or older developed the anomalies described even though thyroid was administered. In children suspected of being the victims of thyroid deficiency, the roentgenogram is helpful in determining whether the teeth that should have erupted are entirely absent or dentition is merely delayed. Roentgen-ray films of the carpal bones are also helpful. Thyroid deficiency causes a retardation in the development of these bones.

Marinus[1] expressed an opinion, with which I do not agree, that, on reaching puberty, the hypothyroid cases sometimes show premature development of secondary sex characteristics. When this occurs, he says, there is some disturbance in the eruption and shape of the permanent teeth. The maxillary central incisors are said to be overlarge, the lateral incisors being much smaller. He is of the opinion that the oversize teeth are well calcified and resistant to caries and that the small ones are poorly calcified and prone to early disintegration. That there is some relation between the size, shape and quality of the upper incisors and the gonads is true. This will be discussed more fully under the gonads.

In adult life, hypothyroidism is frequently associated with sponginess, bleeding and recession of the gums and with many cases of pyorrhea. The relation to the last named is probably through the thyroid's effect on the general health. In adult myxedema, the teeth may decay rapidly and fall out.[3]

It is generally agreed that, in thyroid deficiency, the permanent teeth are late in appearing, irregular in size and poorly developed. Engelbach[2] has noted that much of this can be prevented by attention to the infantile thyroid deficiency. He believed that the deciduous teeth were slow in erupting and were retained to a later age than normal, with the result that the permanent teeth were pushed out of place and forced to erupt in abnormal positions, with the resulting malocclusion seen in adults suffering from hypothyroidism.

2. Engelbach, William: Endocrine Medicine, Baltimore: Charles C. Thomas, Maryland, 1932. Vol. 2, p. 454.

3. Lisser, Hans: Bedside Diagnosis, edited by George Blumer, Philadelphia: W. B. Saunders Co., 1928, Vol. 3, p. 155.

If the dentist suspects thyroid deficiency as being partly responsible for the condition of his patient's teeth, he can easily note some confirmatory signs. The skin is apt to be dry and coarse. The nails are brittle, longitudinally ridged and contain white spots. The hair is apt to be coarse and dry. The outer third of the eyebrows may be thin or missing entirely. The dentist noting any of these signs might well ask the patient to undergo a thorough endocrine survey. Even in adult years, thyroid medication to correct a well marked deficiency is followed by considerable improvement in the conditions in the mouth. The teeth seem to share in this improvement.

Whether the opposite condition, hyperthyroidism, affects the teeth adversely is not known; but, many times, toxic goiter is associated with oral sepsis. Whether it is causal or coincidental is not well understood. Regardless of the relationship, the aid of the dentist should be invoked to see that the mouth is put into the best possible condition. A good many men refuse to undertake the treatment of a goiter unless the patient will have his dental defects corrected first or coincidentally with medical care..

THE PARATHYROIDS

The trouble which women experience with their teeth during pregnancy led to the old Greek saying that every baby costs the mother a tooth. The work of Richardson[4] and others has made it possible to offset this idea and has shown that through an adequate amount of calcium and viosterol, the mother's teeth can usually be preserved. The effect of this on the baby's teeth has not yet been determined. Undoubtedly, the parathyroids play some part in this picture.

4. Richardson, G. C.: Rôle of Viosterol in Pregnancy, Illinois M. J., 59:453 (June) 1931.

Experimental Work.—It has been shown that removal of the parathyroids is followed within from six to ten weeks by the appearance on the teeth of spots which show meager calcification of dentin and absence of enamel. Such teeth break easily and destructive ulcers soon appear on the fracture surfaces of the lower cuspids. Correction of this parathyroid deficiency by transplantation of a parathyroid into the spleen or muscle allowed the teeth to resume their normal development, leaving only calcium-poor zones as histologic evidence of the former disturbance.[5]

In the parathyroid tetany of children, we see enamel defects with transverse furrows, horizontal grooves and some punctate holes, the incisors and cuspids being most often affected.[6] Fleischmann[7] observed that the teeth of children with rickets and tetany show rows of pitlike depressions extending horizontally across the tooth, sometimes one row and sometimes several. He believes that persons who have had tetany in the first or second year of life, that is, at a time when certain of the teeth develop (most often the first molars, the middle upper incisors, the cuspids and the lower incisor teeth), carry throughout life typical enamel defects; whereas, when the tetany occurs between the third and fifth years of life, the enamel defects are seen in the second bicuspids and in the second and third molars. He emphasizes the fact that it is not a single tooth that shows this hypoplasia of enamel, but that it is in evidence on all the teeth that happen

5. Weil, Arthur: Internal Secretions, New York City: Macmillan Company, 1924, pp. 112-114.

6. Footnote 3, p. 34.

7. Fleischmann, L., mentioned in Barker, L. F. et al. (editors): Endocrinology and Metabolism, New York City: D. Appleton & Co., 1922, Vol. 1, pp. 1615-1616.

to belong to the developmental period of the time when tetany occurred. He says these enamel defects have nothing to do with rickets, as was formerly supposed, but are wholly due to the disturbance of parathyroid function and of the calcium metabolism accompanying it. When parallel rows of defects are visible in adults, the terrace-like or staircase-like appearance of the teeth permits one to assume the existence of a recurring tetany during the developmental period. The dentist noting these things should inquire about spasmophilia, laryngospasm and other spasms in early life. Other writers[8] agree in the main with these observations.

On the other hand, artificial hyperparathyroidism induced by the injection of the parathyroid hormone is associated with disturbances in the calcification of the dentin. Schour[9] and his associates noted that multiple injections of parathyroid hormone were followed by the appearance of a number of stripes on the teeth, these stripes being areas of hypoplasia of the enamel. When the injections were discontinued, a hypercalcified stripe appeared. They theorize that injection of the hormone results first in a shift of calcium from the tissues to the blood so that less calcium is available for the teeth. When the effect of the parathyroid hormone has passed, the calcium held in solution under its influence is shifted from the blood back to the tissues, the hypercalcified stripe resulting.

In clinical hyperparathyroidism, cysts or giant cell tumors sometimes occur in the jaw as well as in other bones of the body. These lesions are liable to occur at a point of injury and consequently may appear in the jaw from which a tooth has been extracted.[10]

THE PITUITARY

Curiously, hypopituitarism is frequently accompanied by quite early eruption of teeth, sometimes as early as the fourth month. They are always small. Sometimes, they are regular and evenly placed. In other cases, the shortage of growth hormone in the anterior lobe is apparently involved more severely in the teeth than in the rest of the body, with the result that the teeth are even smaller than is proportionate for the jaw and are consequently widely spaced, the condition resembling in this respect the effect of acromegaly, in which the teeth are widely spaced because they do not share in the growth of the jaw under the influence of an excess of the growth hormone.

Marinus[1] believes that pituitary deficiency in childhood plays no part in any orthodontic problem. He says that, as the victim approaches puberty, there may be some increase in growth which does not affect the body equally in all its parts, with the result that the mandible may develop little or not at all, while the maxilla may be normally developed, with all of the irregularities that this leads to. He says correctly that these people appear younger than their years, with a corresponding immaturity of personality. Under pituitary medication, Marinus[1] has noted definite stimulation of growth with widening of the arch, such as ordinarily occurs with the use of orthodontic appliances. With this statement, most endocrinologists would agree, suggesting

8. Foster, N. B.: Nelson's Loose-Leaf Medicine, New York City: Thomas Nelson & Sons, 1920, Vol. 3, p. 311F. McCrae, Thomas: Osler's Modern Medicine, Philadelphia: Lea & Febiger, 1927, Vol. 5, p. 419.

9. Schour, Isaac; Tweedy, W. R., and McJunkin, F. A.: Effect of Single and Multiple Doses of Parathyroid Hormone on Calcification of Dentin of Rat Incisor, Am. J. Path., 10:321-339 (May) 1934.

10. Barr, D. P.: Oxford Medicine, New York City: Oxford University Press, 1921, Vol. 3, Part 2, p. 838 (16).

that both appliances and pituitary medication be used.

Engelbach and others[11] have called attention to the fact that in dystrophia adiposogenitalis, the teeth are broad and malformed. The upper and lower central incisors are widely spaced.

Simmonds' disease (hypophysial cachexia), which is due to an almost or quite complete failure of the anterior lobe in adult life, is sometimes associated with caries, and sometimes the teeth are lost without caries.[12] Lesser degrees of pituitary failure are undoubtedly associated with some dental defects of this nature, but of lesser degree.

The effect of hyperpituitarism on the teeth varies, of course, with the age of the patient. If it begins in early life and is of such degree as to lead to gigantism, the teeth, of course, share in this overgrowth. Authorities differ as to whether the teeth are also of good quality. My experience leads me to believe that they are not; that usually they have a lack of quality to make up for their excess in size. I recall a giantess 20 years of age, 6 feet, 6 inches in height, and weighing 350 pounds. Her teeth were nearly all broken off at the gum line. Engelbach[13] was of the opinion that hyperactivity of the anterior lobe is associated with the presence of unusually large teeth having increased density. This is probably true only within rather narrow limits. As just mentioned, giants many times have teeth of very poor quality.

The acromegalic owes his condition to the fact that his pituitary took on added activity after he arrived at adult years. This results in a separation of the teeth, particularly the lower teeth, and as the jaws grow to produce the protruding effect, the bite is very largely lost. Barker,[14] commenting on acromegaly, noted that it is responsible for the appearance in the upper jaw of what are known as hag's teeth. He said that Shakespeare mentioned the occurrence of such teeth in connection with an increase of libido. Keith[15] examined all the acromegalic skeletons to be found in London and concluded:

> The width of the last lower molars is increased in the mean by nearly 10 mm. so that the right and left lower molars in place of being nearer together than the upper are wider apart and project beyond the upper dental arcade. The canines are advanced so as to come more nearly into a transverse line with the incisors.

When both the thyroid and the pituitary are deficient in childhood—and usually the two are closely associated—the malar bones are liable to lack development, so that these conditions are a considerable factor in dental malalinement.

THE GONADS

The relation between gonadal disturbance and teeth is commented on throughout endocrine literature, but the exact relation between the two is not yet understood. Gonadal deficiency occurring in juvenile years is associated with teeth of poor quality which show signs of decalcification and develop caries early. It is generally agreed that the upper central incisors are large and the lateral incisors small. The cuspids may be pointed and are rudimentary and usually of poor quality. The cuspids are usually referred

11. Footnote 2, Vol. 3, p. 512. Beck, H. G.: Endocrinology & Metabolism, New York City: D. Appleton & Co., 1922, Vol. 1, p. 876.

12. Silver, Solomon: Simmonds' Disease (Cachexia Hypophyseopriva), Arch. Int. Med., 51:175-199 (Feb.) 1933.

13. Footnote 2, Vol. 2, p. 212.

14. Barker, L. F.: Clinical Medicine, Philadelphia: W. B. Saunders Co., 1922, Vol. 1, p. 572.

15. Keith, mentioned in Endocrinology and Metabolism, Footnote 7, New York City: p. 831.

to as the suprarenal teeth and normally functioning suprarenals are said to be associated with cuspid teeth of very good quality. This may be true, but whether there is the causal relationship implied, we do not know. It should be noted that hypogonadism is usually associated with suprarenal insufficiency of some degree and that, on the other hand, active functioning or hyperfunction of the suprarenals, as exhibited in cortical tumors or hyperplasia, is associated with a corresponding hypergonadism, shown in the extreme cases by precocious sexual development and increased libido. In this connection, it should be recalled that the suprarenal cortex and the gonads are very closely related embryologically. Engelbach[16] noted more than a decade ago that gonadal deficiency affected the lateral incisors and the cuspids, particularly the upper. Certain writers[17] are of the opinion that the presence of strikingly small upper lateral incisors or their absence is indicative of hypogonadism and that the presence of pointed cuspids is indicative of ovarian or suprarenal disturbance of some sort.

The teeth of victims of hypogonadism are prone to early decay. Dental appliances, fillings and inlays are liable to be retained but a short time. More or less oral sepsis is likely to be present. This condition, which probably influences the permanent rather than the temporary teeth, is probably associated with some lack of development of the jaw which is responsible for malocclusion. This indicates the involvement of the pituitary and again demonstrates how close the relation is between the gonads and the anterior lobe.

16. Engelbach, William: Oxford Medicine, New York City: Oxford University Press, 1921, Vol. 3, Part 2, p. 995.

17. Footnote 3, p. 36.

THE SUPRARENALS

In the severe form of suprarenal deficiency known as Addison's disease (bronzed skin), there is considerable pigmentation about the mucous membranes of the mouth. The lips are usually dark, especially at the corners of the mouth. There are dark spots on the gums, the hard palate and soft structures in the mouth. These areas of pigmentation are frequently observed at points where orthodontic appliances are attached. These spots may vary in size from small specks to areas 2 cm. in diameter. Suprarenal insufficiency apparently has little effect on the teeth. They might be involved later in Addison's disease, but probably because of its profound influence on the general health.

There are some rather rare endocrine conditions associated with unusual development of the teeth. Pineal tumors affect boys. At least as far as I know, a case has never been reported in a girl. These tumors are associated with a precocious sexual and somatic development in which the teeth share. Tumors of the suprarenal cortex, which may occur in either sex, are also accompanied by precocious sexual and somatic development. Tumors of the gonads produce similar pictures. All of these are rare conditions, with which the dentist is not likely to be involved.

Acromegaly may be suspected by the dentist before any one else sees the patient. One of the first conditions that bother the acromegalic may be an increasingly troublesome malocclusion. The dentist who recognizes this condition can render the patient a great service by insisting that he begin treatment early. Other pituitary disorders are more difficult of diagnosis, and there is no reason that the dentist should be burdened with a recital of various symptoms and the laboratory findings accompanying them.

Rowe,[18] in summing up the results of the examination of a large group of patients, says that in all the cases of endocrinopathy, poor teeth were reported in a number exceeding that of the nonendocrine group, and he comments on the high incidence of poor teeth in the gonad group. The poor condition of the diabetic's teeth is a matter of common observation. Joslin[19] found that 41 per cent of a series of his patients had poor or false teeth and he stated that the dental hygienist at the Deaconess Hospital found that of 600 diabetic patients, one-half showed caries.

SUMMARY

Development of the Jaws.—Pituitary deficiency in infancy and youth leads to a lack of development of the jaws. The dental arch is liable to be narrow. The teeth may be small to correspond with this lack of development so that there is no crowding and no malocclusion. In some cases, the teeth are so small as to be widely spaced. The dentist is likely to see the acromegalic before any one else because the latter is disturbed by the malocclusion. The recognition by the dentist of the underlying factor in this case gives the patient the best opportunity for the arrest of the disease without further disability. Tumors of the jaws, particularly those occurring at the site of an injury, such as a tooth extraction, should raise the question of hyperparathyroidism.

Eruption of the Teeth.—The thyroid apparently plays the most important rôle of all the endocrines. Its deficiency in infancy is accompanied by delayed and irregular eruption of the teeth, with consequent irregularity in their size. The teeth are of poor quality and prone to early decay and loss. As the deciduous teeth are slow in erupting, they may be retained beyond the usual age, with consequent delay in the appearance of the permanent teeth, and these may be forced to come in at abnormal places, with consequent irregularity and poor quality leading to early caries and loss. Hypopituitarism involving particularly the anterior lobe is sometimes accompanied by a precocious appearance of the teeth, sometimes as early as the fourth month.

Placement of the Teeth.—From the foregoing, it will be seen that the thyroid is the most prominent influence. Pituitary deficiency is associated with small teeth, but they are usually normally placed, regularly spaced and of poor quality. Hyperpituitarism, if of marked degree and occurring in early life, leads to overgrowth, which may amount to gigantism. The teeth are likely to be large and may be regularly placed, but, in my experience, are usually of poor quality and given to early decay. Hyperpituitarism occurring later and leading to acromegaly causes the teeth to be widely separated, and there is malocclusion with its long train of symptoms.

Condition of the Teeth.—The thyroid again plays a dominant rôle. The patient with thyroid deficiency from early life nearly always has poor teeth. They are soft, decay easily and respond poorly to dental care. Fillings and appliances do not stay in place, and thyroid deficiency may defeat the most skilful dentist in his efforts to assure the patient good teeth or help him to retain them. Hypopituitarism occurring during the developmental years is usually associated with small teeth, which, in my experience, are usually, but not always, of poor quality. Giants' teeth decay early. Parathyroid deficiency probably is accompa-

18. Rowe, A. W.: Differential Diagnosis of Endocrine Disorders, Baltimore: Williams & Wilkins Co., 1932, p. 52.

19. Joslin, E. P.: Treatment of Diabetes Mellitus, Ed. 4, Philadelphia: Lea & Febiger, 1928, p. 728.

nied by enamel defects, which may show as spots or as transverse grooves.

The gonads undoubtedly have considerable influence on the development and condition of the teeth. This is probably because the gonadal hormone tends to neutralize the growth hormone and to bring about cessation of the growth of the bones. If the gonads are deficient, growth is likely to continue to a later age than normal and perhaps at a greater rate. It is accompanied by an overgrowth of long bones. These patients usually exhibit large upper central incisors, which more often than not are of poor quality. This oversize of the central incisors seems to be at the expense of the size of the lateral incisors and the cuspids, all of which may be small, even rudimentary, and sometimes one or another is missing. They are almost always of poor quality. Hypergonadism, particularly that associated with pineal tumors or hyperplasia or tumors of the suprarenal cortex, is associated with precocious appearance and development of the teeth. As both conditions are usually fatal at an early age, their dental aspects are secondary features.

The Gums.—Thyroid deficiency, whether it occurs early or late, is associated with gums that are spongy, bleed easily and are apt to recede from the teeth.

How can the dentist guard himself against defeat by endocrine disorders which have not been recognized prior to the time he sees the patient?

He should remember that certain of the endocrines have a profound influence on the development of the teeth, gums and jaws and that the thyroid makes its influence felt earliest and probably most frequently. When the signs of hypothyroidism referred to are present, the dentist should shift the responsibility to the physician and send the patient to him for an endocrine check-up. He might well do the same thing when the patient has sponginess, recession and bleeding of the gums and pyorrhea.

Irregularity in the time of eruption and development of teeth should also arouse his suspicion of thyroid deficiency. Separation of the lower teeth and malocclusion should raise the question of acromegaly. A wound that does not heal promptly after extraction of a tooth should lead to the question of diabetes. The appearance of an undue swelling at the site of an extraction should raise the question of hyperparathyroidism.

In adolescence or early adult years, irregular placement or smallness of the teeth or caries and early decay should raise the question of pituitary deficiency. This may be indicated by the history of previous lack of growth followed by rather rapid growth at or about puberty, which may be manifested irregularly over the body, leading to various degrees of malocclusion. The face may be more youthful in appearance than the years would indicate, and in some instances there may be facial asymmetry. When the dentist suspects hypopituitarism, he should inquire as to the height and weight of the parents, brothers and sisters of the patient. The hereditary nature of endocrine disturbance is more readily apparent in the pituitary than in any of the others.

Decalcification of the teeth occurring at an early age should prompt an investigation of the thyroid, parathyroid and pituitary functions with their effect on calcium metabolism. This investigation is obviously something that should not be expected of the dentist. A brief inquiry into the life history, particularly as regards spasmophilia, tetany, rickets and

the rate of growth, would give him a more intelligent picture of the patient's condition and place him in a position the better to demand a thorough investigation on the part of the physician to whom the case is referred.

PLASTIC SURGERY OF THE HEAD, FACE AND NECK; THE PSYCHIC REACTIONS*

By VILRAY P. BLAIR, M.D., F.A.C.S., St. Louis, Mo.

CERTAIN facial defects are so evident or are so crippling that one is not likely to seek less obvious reasons for attempting their correction, and he who undertakes to do this work is usually so busy unraveling the details that make up the deformity and trying to evolve a plan for improvement that it may be considerable time before it is borne in on him that these patients frequently have a reaction or a point of view not taken into consideration in his plan. The patient's hopes cannot greatly influence the general plan of restoration if the surgeon is not cognizant of them, and yet the apparently off-hand "I just want something to improve it a little" may hide a world of far-reaching desires, perhaps most difficult of fulfillment.

Partly because it is easier to make a showing on a very evident abnormality than on a slight variation from the normal, and partly because of our natural and just assumption of the functions of judge, jury and, one might say, executioner in deciding just what is proper for the particular case, we are prone to estimate the importance of minor defects and variations purely on their physical proportions and on the mental attitude of the patient. In this, we are influenced by conscientious scruples, by consideration of the great amount of time and energy required for the correction of these minor details and by a feeling of resentment at being called on to belittle our profession by catering to the vanities and frivolities of life. Therefore, it is but natural that when the misguided come in with minor defects, the surgeon often dismisses them with some good advice instead of preying on their pocketbooks.

I was reared in the most orthodox medical surroundings, with an unquestioning belief in the correctness of the underlying ethics and rules of practice of the profession. As a result, for years I put aside more opportunities to prostitute the art than I yielded to, and, in the light of later observation, I now feel that I neglected more opportunities to do good than otherwise. It took more than a few patients, discontented after what seemed to me a rather satisfactory restoration, and a few real or attempted suicides after a supposedly satisfactory explanation as to why the sufferer should forget his trouble, to make me, the satisfied surgeon, realize that there might be more angles to this work than were contained in my philosophy.

Never having remained perfectly content with the visible results in a single one of my own cases of facial repair, I have had to turn to some other phase of

*Read before the Section on Oral Surgery, Radiology and Anesthesia at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 20, 1935.

the subject for a little of the satisfaction which is so necessary to hearten one's efforts; but, in finding another source of consolation, I also located the source of my greatest worries. The phase referred to is the "other fellow's" reaction, and in the other fellow is included the patient, his family and his associates.

If the happiness we give, and the discontent and brooding we help to eliminate, are of any weight in estimating the dignity and usefulness of our services, we may safely give some heed to these frivolities and vanities, but we will be in great luck if the personal satisfaction thus derived compensates for the extra worries and trouble essential to such practice. Like bad habits, the patient of this type is easy to acquire and often unsatisfactory, and may be difficult to dismiss.

Until we are capable of attaining the now impossible in facial restorations, we should recognize and give due consideration to the patient's motives and point of view. Otherwise, we neglect one of the most important elements in the pathology of the disease which we assume to treat. The disability of this class of handicapped is due chiefly to their mental reaction, and while the faulty mental attitude, in a certain percentage of patients, may be improved or corrected by kindness, change of circumstances or environment or the patient's assumption of responsibility, it is extremely rare that these patients can be permanently reasoned out of their mental attitude. Not all of them react in the same way. Some who have a revolting facial condition seem to be perfectly unconscious of anything wrong. Even a sister's voluntary absence to avoid the daily sight of one of these patients failed to disturb the self-satisfaction of the latter, who in every other way was habitually considerate.

The majority of patients are not content. A physician prominent in his locality and of extraordinary attainments and accomplishments, after several years of protest, consented to bring in a member of his family who was unhappy because of an uncongenial feature. Having completed the arrangements for its correction, he diffidently called attention to a not very noticeable weakness of the inframaxillary branch of the motor facial nerve which he had had since student days. Of this, he said he was so conscious that, though always ambitious to do so, he had never been able to read a paper before a medical body.

Weaklings are not the only ones adversely affected by self-consciousness. This otherwise well-balanced physician is one of a very large class.

The remedy that least seldom fails is not just good surgical procedure, but a satisfying procedure. Except for artificial eyes, teeth and hair, a prosthesis will seldom be tolerated as a substitute. It is possible that the "man with the iron mask" may have assumed that disguise voluntarily, but that is not the usual interpretation of the incident. The modern tendency is to discard all superfluous coverings or crude disguises, whether whiskers, veils or clothes; and if a feature is damaged, to have it repaired if possible. In civil life, the people who will wear an artificial feature are an extremely small minority; and those who do usually allow the prosthesis to get so shabby for want of paint and repair as to suggest that it is worn for some reason other than any real concern about the appearance. I was in a position to observe most of the facial injuries in the American forces, and I do not know of a single instance in which a wounded soldier voluntarily continued to wear one of these shop-made appliances, although the government spent quite a large sum to provide them.

The patient may not recognize the basic fault any more than another would

necessarily know that his appendix is causing his misery; but there is something there that he wishes changed, and it is the surgeon's responsibilty to find out what it is and to accomplish a change that will fit the patient's desires, not his own ideas. This is not always so easy as it would seem, since certain patients misstate the facts in the belief that the fabricated plea is more likely to obtain for them what they seek than a true statement. In most cases, the surgical procedure can be made to eventually meet their demands, but there are some patients whom it is impossible to satisfy in this way. To help the latter class, one must educate and discipline them out of their purely selfish attitude. This can sometimes be done by doing enough to stimulate their hope and interest, and then refusing to go on with the work until they discard all facial covering and face facts.

One of the most common facial deformities is the congenitally open cleft of lip or palate. This has a whole train of unpleasant possible sequences, partly physical, but chiefly dependent on the mental reaction of the patient or of those associated with him. The parents of such a child are likely to feel that they may be in some way responsible and this feeling accentuates the worry and sorrow, and often causes them to further complicate the situation by overindulgence of the child. With a sensible attitude on the part of the parents, good early repair and proper training, the effect may be largely obliterated; but this is not the rule. Usually, the external deformity remains noticeable throughout life. In spite of the best obtainable palate repair, the articulation may be faulty and relative deafness often develops. As a result, the teacher in the ordinary classroom cannot well understand the child, nor the child the teacher; so the child is allowed to drift along, getting less than the other children. This often leads to dreaming, morbid self-consciousness, an inferiority complex and a disinclination for conversation and social intercourse. A strong indication of the child's reaction is to be had in the older surgeon's recommendation that the operation be postponed until the age of 12 or 14 years, as he would then be willing to cooperate and submit to the palate or lip operation without an anesthetic.

Noma has either been a very common disease in the years recently passed or a much larger number of cases must have been successful than we ordinarily credit to our skill. It is surprising how many children must have been so afflicted and come in for the correction of the supposed results of salivation. The effect on the patient is even more disastrous than poor lip or palate, for the child's appearance is often such as to preclude his attendance at school, and the resulting lack of mental and moral training is much more exaggerated. Many of these children get their first school work in the wards of the hospital, and the first taste of salutary discipline from the control necessary in their treatment. Severe burn cases are somewhat similar in their results. Anything which attracts especial attention to a child, except acquired merit, is not good for its morale, and when this something is a deformity, the results may be very disastrous.

In these days when the once hidden things of life are the favorite subjects of display advertisements and of discussion, syphilis has become a subject for parlor conversation, with the result that every depressed nasal bridge is regarded by the semisophisticated as synonymous with moral obliquity, personal, conjugal or parental. Although the true syphilitic saddle nose is today a relatively rare deformity, it is nevertheless perfectly logi-

cal that the bearer of a caved-in bridge, whether due to early injury, cartilage infection, septal resection or atavism, should be anxious to have the supposed evidence of a syphilitic inheritance eliminated as nearly as possible.

Further, if one type of nasal defect can be corrected, why not others, real or fancied? For instance, change in the shape of the pronounced Jewish nose may be sought for either social or business reasons. There are many other types of variation for which change may seem desirable to the patient. Some of these cases will appeal to the surgeon's ingenuity and esthetic sense, while certain requests will appear preposterous; but all represent a cry for help and a discontent with things as they are.

The total lack of an ear, next to the total loss of the nose, is the most glaring of facial deformities, but there is this difference between them: To be acceptable, the nasal restoration must be good, and natural in appearance, and, fortunately, this is a surgical possibility. On the other hand, while it is impossible to make a natural appearing total restoration of the ear, few people even look at an ear except to note its loss, and, if the substitute stands out from the head and has the general outline of its fellow, it usually passes observation very well. Pronounced changes in shape and prominence are not uncommon and these particularly worry the mother.

Total loss of the contents of an orbit and its appendages falls rather in a class with ear defects. A much less noticeable condition will usually result from covering the area with a plain flap than from an elaborate attempt to reconstruct the lids and the socket for an artificial eye.

The chin is commonly regarded as an indicator of character, and, while we can find no direct logical reason for this belief, certain it is that consciousness of a lack of chin may be a real handicap in life's struggle; and the mere building out of this prominence is sometimes followed by most surprising manifestations of previously submerged force. It is questionable how much the present common use of cosmetics does of itself improve the appearance of our women, but it seems to lend a confidence to the less favored, and they dress up to the part, until a noticeably homely or slovenly looking woman is now a rarity. By the same token, building out the chin seems capable of influencing the mental attitude as favorably as cosmetics do the dress and general appearance.

The women who crave beauty may present special problems. Most of them are grateful for any improvement, but others will not be made happy until they have attained the maximum of attractiveness that is possible to them. Often, unreasonable demands may be based upon the perfectly legitimate desire to attract a sweetheart, or hold a husband. In a number of cases, women have refused to go on with a prearranged marriage until they have had a defect corrected. For them to get married is always desirable, for there is nothing that will so effectually overcome their self-consciousness as the care of their own baby.

The subject of paraffinoma presents a particularly difficult problem. Except those who had had a true saddle nose, patients with paraffinomas are, as a class, women and men who were not content with average normal faces and who now have real deformities as the result of their efforts at improvement. This is true of other attempted corrections of fancied deformities. When liquid mineral oil has been injected, the most horrible deformities can result, and the devastation may be so widespread as to be impossible of correction. Some are grateful

even for the relief of pain, but it is doubtful that they can ever be made more than comparatively satisfied. The final discharge of certain of these paraffinoma cases and of cases of certain other injuries must be indefinitely postponed, since the occasional operation helps foster that hope which alone sustains the patient.

The school teacher who has a facial peculiarity that focuses the children's attention, and the business woman, who, from the erosion of passing years, finds it increasingly difficult to hold her own or to progress, are especially worthy of consideration. The former seeks relief because of all kinds of defects, even after almost a lifetime in the work. Among the older business women, it is usually the elimination of wrinkles and sags that is sought.

If a woman has a thin face with much sagging and many wrinkles, it is a real joy to more or less permanently eliminate twenty years or more from her appearance by a real hospital operation. Where there is any considerable amount of subcutaneous fat, the operation is bound to be disappointing, except when this fat is removed from a double chin.

Postwar experience developed quite an interesting comparison between the civilians who had extensive facial loss from cancer treatment, and soldiers who suffered lesser losses, on the average, in military service. The former gives grudgingly the necessary time, accepts gladly any practical repair and gets back to his work as soon as possible. The soldier, having been involuntarily hospitalized as the result of military necessity, will, in quite a number of instances, exert all possible influence, and submit to or demand a number of operations of sometimes questionable necessity to prolong his hospitalization and disability as long as possible. The reasons for this are not hard to find. The maimed cancer subject is usually past middle life, with habits of industry and responsibility already established. On the other hand, the long hospitalized soldier has lost both touch and sympathy with the past and present of civil life, and politics has forced the government into the questionable policy of putting a premium on idleness. Simple observation by one who was interested in and worked with these wounded soldiers led to the impression that the Jew, the foreign born or those reared by foreign born parents snapped out of this Slough of Despond more readily than did the average husky young man with more thoroughly American traditions.

An attempt has been made to illustrate some of the handicaps that are often associated with the simpler problem of the surgical restoration of the deformed face. In determining which cases will be accepted and which refused, I have ceased to judge motives, but try to determine whether the condition, physical and mental, warrants, or the patient merits, the time and energy likely to be expended, and whether it is likely that what the patient hopes for can be realized.

ADMINISTRATION OF LOCAL ANESTHETICS IN DENTISTRY*

By P. G. PUTERBAUGH, M.D., D.D.S., Chicago, Ill.

IT is quite generally conceded that local anesthesia as employed today is far more satisfactory than it was even a decade ago. This fact may be attributed to two distinct lines of research which have contributed to its present popularity. The first has been the compounding of anesthetic solutions which are compatible with the tissues into which they are introduced, as to both isotonicity and alkalinity. The solutions that we now employ are absorbed so quickly that they produce almost instantaneous anesthesia and remain active in the tissues long enough for a single administration to give ample working time for any ordinary dental or oral surgery operation. The other factor in the rationalization of local anesthesia within the oral cavity is the better understanding of the anatomic structures of the teeth and their supporting tissues, which has been made possible by a refinement of the technic of preparing sections of jaws for microscopic study.

For twenty-five years after the discovery of cocaine, it was common practice to infiltrate the gingival margins with cocaine solutions prior to extracting teeth; but, strange as it may seem, the source of the sensory nerve supply to the peridental membrane was almost wholly disregarded. This practice continued until 1908, when, under the guidance of Braun and Guido Fischer, the pendulum swung, with one mighty sweep, to the other extreme of injecting anesthetic solutions only at the foramina of entrance or exit of the principal nerve trunks which innervate the teeth and their adjacent structures. Dentistry has never done things by halves, and the stampede from the ultraconservative and inefficient infiltrations of twenty-five years ago to the bold injections of the early conduction anesthesia enthusiasts was no exception. In spite of the hazards that we now know to accompany local anesthetic injections at the posterior infra-orbital, anterior infra-orbital and mental foramina, the profound anesthesia secured by this new method was so gratifying that the untoward effects were, for a few years, entirely ignored.

As time passed and reports of blood vessels being pierced with needles, allowing blood to leak into the surrounding tissues, began to accumulate, conservatism again asserted itself, and one by one the rank and file began to shun deep injections in those areas most liable to such accidents. Although we have never known a fatality from the accidental puncture of a vessel during an injection for dental purposes, the swelling, pain and discoloration which frequently persist for a week or two while the disintegrated hemoglobin is being carried away by the circulating fluids make a very uncomfortable period for the patient and a

*Read before the Section on Oral Surgery, Radiology and Anesthesia at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 19, 1935.

most embarrassing one for the dentist. It is true that this accident sometimes happens even in very superficial injections; but it rarely follows infiltration injection limited to the dental areas of the upper arch, the lower incisors or the pterygomandibular injections for anesthetizing the mandible.

It has long been known that the major innervation of the supporting tissues of the teeth in the upper arch is by branches of the infra-orbital nerves which traverse the bone immediately beneath the external cortical plate to the apical regions of the teeth, and that their terminal fibers then perforate the alveolar process to innervate the soft tissues of the gingival and buccal areas. In the palate, the two posterior palatine foramina and the incisive foramen transmit nerves which innervate the soft tissues of the entire palate, but have little if any distribution to the pulps of teeth.

Among other things revealed in large histologic sections, it is especially interesting to observe the uniform contour of the labial plate of alveolar bone and its relationship to all teeth in the upper arches and to the anterior teeth in the lower arches. In all cases studied by us, there is a marked thickening of the labial alveolar process, forming a ridge along the gingival third of the roots of the teeth. A short distance apically from the gingival ridges, the osseous tissue thins down, and it is very thin over the entire middle third of the roots. As the alveolar plate continues over the apical third of the roots, it again undergoes a marked thickening, as the labial and buccal plates curve outward. It is at the points where the labial alveolar bone is thinnest that it is also the most porous, and clinical experience has demonstrated that local anesthetic solutions are most rapidly absorbed when infiltrated in those regions.

For anesthetizing the teeth in the upper arch, a technic which is practically devoid of complications is as follows: For anesthetizing the pulps, in any of the teeth in the upper arch or the four lower incisors, infiltration of 1 c.c. (16 drops) of a local anesthetic solution infiltrated into the labial or buccal tissues adjacent to the periosteum at the junction of the middle and apical thirds of the roots gives excellent results. For exodontia, injection of 0.5 c.c. (8 drops) of solution into the palatal tissues in addition to the foregoing labial injection will complete anesthesia in the area. In young patients or in hyperemic tissues of older patients, these amounts should be increased by one-half, or even doubled, in order to offset that which is washed away by the circulating fluids. Conversely, in anemic patients, the amounts injected may be reduced to 8 or 10 minims on the labial surfaces and 5 to 6 minims on the lingual or palatal surfaces.

The innervation of the pulps and the tissues surrounding the teeth in the lower arch is by the inferior dental and lingual nerves, which lie in close proximity to each other in the region of the mandibular foramen. In addition to the foregoing, in the bicuspid and molar areas, the buccinator nerve, another branch of the third division of the fifth nerve, innervates the gum along their buccal surfaces and must be anesthetized by a second injection when teeth are to be extracted.

Because of the extremely thick buccal and lingual plates of alveolar bone overlying the mandibular cuspids, bicuspids and molars, conduction anesthesia produced by injecting 1.5 c.c. (from 24 to 32 minims) of solution in the pterygomandibular space remains the method of choice; and since it is remote from all except the third molars, it is applicable to practically all cases, even when acute infection has localized about the teeth. This single injection suffices for pulp extirpa-

tion, cavity preparation, exodontia, etc.; but for exodontia in the bicuspid and molar areas, anesthetization of the buccinator nerve must also be accomplished by depositing from 0.5 to 1 c.c. of anesthetic solution in the buccal fold, slightly distad from the area to be operated in.

In making hypodermic injections for conduction anesthesia of the mandibular teeth, the technic has also been greatly simplified. Instead of changing the direction of the needle at several points during the course of its insertion as was taught and quite generally practiced a few years ago, the general direction is now maintained on a line extending through the lower first bicuspid on the side opposite the injection and passing slightly mediad from the anterior border of the ramus on the side where the needle is inserted. Changing the course of the needle invites breakage and makes the procedure complicated. The operator should therefore never lose sight of the needle from the beginning of its insertion until its withdrawal, in order to avoid needle breakage. Violent gagging or tongue movements are indications for immediate withdrawal of the needle in order to allow the muscle spasm to subside and the patient to regain his composure before reinjection is attempted.

Most operators have abandoned the mental foramen and infra-orbital foramen injections as routine procedures because they are painful, and on account of the frequency with which they are followed by swelling and ecchymosis.

Gentleness in the manipulation of the syringe and the handling of anesthetized tissue is especially important. The practice of boldly thrusting a hypodermic needle deeply into tissues not previously injected should be discouraged, and careful insertion of the needle coupled with slow injection of the anesthetic solution, allowing sufficient time for it to produce its effect, will aid materially in adding to the patient's comfort and in securing complete anesthesia.

Asepsis must be rigidly enforced—perhaps more rigidly than in open operations in the oral cavity. Within recent years, syringes have been greatly improved by being made lighter, easier to manipulate and easier to sterilize. The use of annealed stainless steel or nickel needles, which may be tied in a knot or will withstand repeated bending without breakage, goes a long way toward solving the problem of accidental needle breakage. The needles should be 25-gage, 1⅝ inches long.

I have endeavored to make clear that absolute anesthesia of any of the teeth in the upper arch is now possible by infiltration of modern anesthetic solutions into the areas immediately adjacent to the teeth. The four lower incisors can be anesthetized in a similar manner to that outlined for maxillary teeth; but the posterior mandibular teeth can only be satisfactorily anesthetized by conduction injections at the mandibular foramen. If skilfully administered, local anesthesia is the greatest single aid that has yet been offered for the promotion of correct cavity preparation, thorough pulp removal and careful exodontia and oral surgery operations.

STUDIES IN TOPICAL ANESTHESIA. I THE EFFICACY OF CERTAIN COMMON ANESTHETICS WHEN USED ON THE GUMS*

By M. L. TAINTER, M.D., and S. M. MOOSE, D.D.S., F.A.C.D., San Francisco, Calif.

AN agent the use of which would promptly and completely anesthetize the gums and mucous membrane of the mouth should be of value in various dental procedures. A large number of topical anesthetic solutions are offered the profession, with claims of definite merit; but, in many instances, without reliable clinical evidence to substantiate the claims. Since the interpretation of such anesthetic action must necessarily involve important subjective factors, it is imperative that conclusions be drawn only when the subjective elements have been carefully excluded. This can best be accomplished by means of the so-called "blind-test technic." The present report is the first of a series on the application of this method to the study of topical anesthesia in the mouth.

METHOD

Solutions of the various topical anesthetics were made by one of us, and supplied to the staff of the oral surgery clinic in bottles labeled only with a code letter. The operators did not know the composition of the solutions being used, but understood that they were preparations to be tested for their value as topical anesthetics. The solutions were used in pairs, each pair being used by the entire staff for a period of weeks, so that any personal differences in interpretation were canceled. The two solutions were simultaneously applied for approximately one minute with cotton applicators on opposite sides of the mouth to the mucous membranes of the gums. Then the swabs were removed and the time of onset, completeness and duration of anesthesia noted, together with any irritative phenomena. The data for each patient were written into a mimeographed form which ended with a question as to which of the two solutions was the better anesthetic.

Seventeen solutions were thus studied on a total of 457 patients. Four normal saline control solutions were included to determine to what extent the factor of suggestion modified the responses. As additional controls, 10 per cent and 95 per cent ethyl alcohol were used, since alcohol is used as a solvent in some of the commercial topical anesthetics. In some solutions, a trace of color and of scent were added to the blank solutions by means of innocuous dyes and very small amounts of volatile oils. The anesthetic agents were dissolved in water or in dilute alcohol, the concentration of the latter being as low as was practicable. These solutions were colored and aromatized as the control solutions were, when necessary.

The following nine pairs of solutions were tested: the Abbott Laboratories

*From the Departments of Physiology and Pharmacology and of Oral Surgery, College of Physicians and Surgeons, a School of Dentistry.

supplying ethylaminobenzoate, butyn topical anesthetic, butyn powder and butesin; H. A. Metz Laboratories, Inc., ethylaminobenzoate and orthoform, and Merck and Co., benzyl alcohol and chlorbutanol:

Pair O-N: Cocaine HCl, 1 per cent in water, colored with a trace of phenol red (O), tested against ethyl alcohol 10 per cent in water, colored with a trace of Congo red (N).

Pair L-K: Butyn 10 per cent in 10 per cent ethyl alcohol, with a trace of green coloring (L) and tested against 0.9 per cent sodium chloride solution with a similar green and a slight odor of oil of spearmint (K).

Pair E-F: Benzyl alcohol 50 per cent in 95 per cent ethyl alcohol (E), tested against 95 per cent ethyl alcohol containing traces of phenol red and oil of spearmint (F).

Pair I-J: Phenol 5 per cent in 95 per cent ethyl alcohol, with a trace of phenol red (I), tested against 95 per cent ethyl alcohol containing traces of gentian violet and methyl salicylate (J).

Pair G-H: Orthoform 10 per cent in 95 per cent ethyl alcohol (G), tested against butesin 10 per cent in 95 per cent ethyl alcohol (H).

Pair D-C: Ethylaminobenzoate (benzocaine) 10 per cent in 70 per cent ethyl alcohol (D), tested against saligenin 10 per cent in 30 per cent ethyl alcohol (C).

Pair B-A: Chlorbutanol (chloretone) 10 per cent in 45 per cent ethyl alcohol (B), tested against "butyn topical anesthetic," A.D.R., which is 10 per cent butyn in 10 per cent ethyl alcohol colored and flavored (A).

Pair T-U: Normal saline solution (0.9 per cent sodium chloride) containing a trace of phenol red and enough strychnine sulfate to give a bitter taste (T), tested against the same solution with the further addition of a trace of oil of spearmint to provide a scent (U).

Pair T-V: Normal saline solution (0.9 per cent sodium chloride) containing a trace of phenol red and enough strychnine sulfate to give a bitter taste (T), tested against normal saline colored green, but having no odor or flavor (V).

The data obtained are summarized in the accompanying table.

RESULTS

It may be seen that the blank saline solutions apparently provided a considerable amount of anesthesia. The poorest one of these, "V," gave some anesthesia in 17 per cent of the patients, and the best one, "K," anesthesia in a total of 54 per cent of the trials. It seems highly improbable that use of normal saline, or physiologic sodium chloride, solution can depress the nerve endings of the mucosa of the mouth. Therefore, the percentages of anesthesia reported for these saline solutions represent errors of observation introduced by subjective factors such as the color and odor of the preparation, variation in technic, needle sharpness and the inability of the operator to determine accurately the presence of anesthesia in a tissue of such low sensitivity as the gums. The psychologic effect on the patient of the suggestion that a solution is being applied to relieve the pain of needle insertion, also the pressure of the applicator on the tissues, may be anesthetic. A pleasant odor and taste seem to add to the apparent efficiency of a solution as shown by the increased amount of anesthesia reported with "T," "U" and "K" as compared to "V," which lacked these qualities. Ten per cent alcohol was very similar in action to the saline solutions, since there was a reported anesthesia in 42 per cent of the cases. Here also, odor and taste of the solution would help to create the impression of anes-

Response (Per Cent) to Various Anesthetic Solutions Used Topically in the Mouth

Agent	No. Cases	Depth of Anesthesia			Initial Irritations		Hyperemia		Sloughs	Comparative Strength			
		Complete	Partial	None	Yes	No	Yes	No		Greater	No different	Less	Agent Compared with
Saline green "V"	40	2	15	83	0	100	5	95	0	15	68	17	Saline "T"
Saline red, bitter taste "T"	81	1	24	75	4	96	7	93	0	21	55	24	Saline "U"
										17	68	15	Saline "V"
Saline red, bitter taste, spearmint odor "U"	42	10	16	74	0	100	0	100	0	24	55	21	Saline "T"
Saline green, spearmint odor "K"	80	21	33	46	5	95	12	88	0	21	21	58	10 per cent butyn "L"
Alcohol 10 per cent, red "N"	40	27	15	58	10	90	10	90	0	20	7	73	10 per cent cocaine hydrochloride "O"
Alcohol 95 per cent, red, spearmint odor "F"	61	21	46	33	40	60	18	82	2	19	44	37	50 per cent benzyl alcohol "E"
Alcohol 95 per cent, violet, wintergreen odor "J"	32	34	38	28	45	55	17	83	0	35	26	39	5 per cent phenol "I"
Butesin 10 per cent "H"	45	42	31	27	18	82	12	88	8	28	30	42	10 per cent orthoform "G"
Phenol 5 per cent, red "I"	38	32	44	24	40	60	15	85	9	39	26	35	95 per cent alcohol "J"

(Continued on next page)

Response (Per Cent) to Various Anesthetic Solutions Used Topically in the Mouth (Concluded)

(Continued on next page)

Response (Per Cent) to Various Anesthetic Solutions Used Topically in the Mouth (Concluded)

Agent	No. Cases	Depth of Anesthesia			Initial Irritations		Hyperemia		Sloughs	Comparative Strength			
		Complete	Partial	None	Yes	No	Yes	No		Greater	No different	Less	Agent Compared with
Benzyl alcohol 50 per cent "E"	61	43	36	21	31	69	11	89	4	37	44	19	95 per cent alcohol "F"
Orthoform 10 per cent "G"	46	52	28	20	10	90	13	87	4	42	30	28	10 per cent butesin "H"
Butyn 10 per cent, green "L"	81	33	50	17	7	93	6	94	0	58	21	21	Saline "K"
Cocaine HCl 1 per cent red "O"	40	15	75	10	5	95	13	87	0	73	7	20	10 per cent alcohol "N"
Butyn Topical 10 per cent "A"	54	37	59	4	35	65	11	89	0	32	18	50	10 per cent chlorbutanol "B"
Saligenin 10 per cent "C"	59	39	58	3	36	64	16	84	2	13	41	46	10 per cent benzocaine "D"
Chlorbutanol 10 per cent "B"	52	44	54	2	23	67	6	94	0	50	18	32	Butyn Topical "A"
Benzocaine 10 per cent "D"	61	59	39	2	33	67	16	84	12	46	41	13	10 per cent saligenin "C"

thetic potency. Reflex inhibitory effects on sensation from the use of odor ferous and irritant solutions or vapors must not be overlooked. These might inhibit painful stimuli in a manner similar to the inhibition of respiration following the application of irritating vapors to the nostrils, the so-called protective reflex. Alcohol, in 95 per cent concentration, was used in two solutions of different color and odor. As anesthesia was reported in 67 and 72 per cent of the cases, respectively, it would seem that the more concentrated alcohol had a greater degree of action than could be accounted for by subjective factors alone.

The use of butesin in 10 per cent strength and dissolved in 95 per cent alcohol caused anesthesia in 73 per cent of the patients; a result which agreed almost exactly with the results obtained with 95 per cent alcohol alone. The addition of butesin, therefore, did not increase the anesthetic potency of the mixture under these conditions. The use of phenol in 5 per cent concentration in alcohol caused some anesthesia in 76 per cent of the patients. Since this is only a little more than the amount of anesthesia reported in the alcohol controls, it is apparent that phenol exerted only a slight additional anesthetic action. The use of 50 per cent benzyl alcohol in a 50 per cent concentration of ethyl alcohol caused some anesthesia in 79 per cent of the patients; which is somewhat more than would be anticipated from the amount of ethyl alcohol in the solution. Therefore, the benzyl alcohol probably exerted some anesthetic effect of its own. Orthoform, 10 per cent, was effective in 80 per cent of the patients, a result which was not much better than that obtained with 95 per cent alcohol, in which it was dissolved. Apparently, the orthoform did not add very much to the anesthetic efficiency of the solution.

A greater degree of activity was shown by 10 per cent butyn solution, since 83 per cent of the patients showed partial or complete anesthesia when this product was employed. The butyn was dissolved in 10 per cent alcohol, but its use caused about twice as deep anesthesia as did the use of alcohol. The proprietary 10 per cent solution of butyn (Butyn Topical, A.D.R.), which contains aromatic principles and coloring dissolved in 10 per cent alcohol, gave 96 per cent of anesthesia, an incidence appreciably greater than would be anticipated from its butyn content. Whether this greater effect is the result of the added factor of more attractive color and odor, or represents a variability in observations, it is difficult to say. Cocaine-hydrochloride, in the weak concentration of 1 per cent in water, was remarkably effective, anesthesia resulting in 90 per cent of the patients. It would seem highly probable that the use of higher concentrations of cocaine, such as are commonly used, would produce complete anesthesia without any difficulty. Saligenin was tested in a 10 per cent concentration in 30 per cent alcohol. It proved very effective, since anesthesia was present in 97 per cent of the patients. This is in confirmation of claims in a recent report of the Council on Dental Therapeutics.[1]

Chlorbutanol was used in 10 per cent concentration in 45 per cent alcohol. It showed a very high degree of anesthetic efficiency, since there was anesthesia in 98 per cent of the patients. Benzocaine, 10 per cent in 70 per cent alcohol, was even more effective, since its use not only produced anesthesia in 98 per cent of the patients but, in addition, it, of all the agents tested, afforded the largest proportion of complete anesthesia (59 per cent). This

1. Report, Council on Dental Therapeutics, J.A.D.A., 22:1589 (Sept.) 1935.

is in accord with its rather common use as a topical anesthetic.

Tabulation of the time periods required for the onset of anesthesia with the various solutions revealed little of significance, since the averages were all close to two or three minutes. The average duration of anesthesia with the weak agents was less than five minutes. With the stronger agents, there was a longer average duration of anesthesia: for cocaine, eight minutes; chlorbutanol, nine minutes, and saligenin and benzocaine, ten minutes. These values can have only a relative significance, since it is extremely difficult to determine precisely the duration of anesthesia in tissues so insensitive as the gums, and, in most cases, other anesthetic solutions were subsequently injected.

Observations were made on the production of burning or irritation at the moment of application of the anesthetic agent. Alcohol 95 per cent proved to be rather irritating, since it caused appreciable burning in almost one-half the patients. Solutions of phenol, benzyl alcohol, "butyn topical," saligenin, chlorbutanol and benzocaine were irritating in approximately one third of the patients. With all of these solutions, except the "butyn topical," the irritation can probably be ascribed to the alcohol present as a solvent. None of the agents produced any important degree of hyperemia or inflammation.

The desirability of some of the most effective anesthetic solutions tried is diminished by their irritant actions, such as those causing superficial necrosis or slough at the site of application. Such an action was not observed with solutions of butyn, cocaine or chlorbutanol, but was present in 12 per cent of patients treated with benzocaine; 9 per cent with phenol; 8 per cent with butesin, and 4 per cent with benzyl alcohol and orthoform. Such irritant action is obviously a serious detriment to the use of a given solution.

The procedure of testing the solutions in pairs permitted an appraisal of the relative efficiency of the agents when compared with each other. Thus, orthoform was found to be definitely better than butesin. Phenol 5 per cent was very little different from 95 per cent alcohol, but benzyl alcohol was markedly superior to alcohol. Butyn 10 per cent showed clear cut superiority to the normal saline solution, but the "butyn topical" was less effective than chlorbutanol. Cocaine was markedly superior to 10 per cent alcohol, but saligenin was definitely inferior to benzocaine.

COMMENT

The choice of an agent for use as a topical anesthetic must involve consideration of a number of factors. First, the agent must be effective in substantially all patients, and, secondly, it must produce the anesthesia without initially burning or irritating the tissues, or later causing necrosis or sloughing. The criterion of anesthetic efficiency would permit the choice of benzocaine, chlorbutanol, saligenin, butyn, "butyn topical" and cocaine as topical anesthetics. Benzocaine should probably be eliminated because its use is associated with a very high incidence of sloughs. The use of cocaine and butyn caused very little initial irritation, whereas this was rather marked with "butyn topical," saligenin and chlorbutanol. Since the three latter agents are not much more effective as anesthetics than are the former, it would seem that cocaine and butyn are the agents of choice. There would be little practical advantage in the use of these two agents over that of "butyn topical," saligenin or chlorbutanol.

Another point worth reiterating is that appreciable depths of anesthesia were obtained, or were thought to have been ob-

tained, with solutions as bland and inert as normal saline solution. When such apparently positive results can be obtained in a "blind test," when there are no suggestive factors, such as fancy bottles, impressive labels proclaiming phenomenal results and high prices for the articles in question, it is plain that, under ordinary clinical conditions, when suggestive elements are allowed full play, a solution of almost anything can be expected to possess some apparent activity. Therefore, the true value of a topical anesthetic for use on the mucous membranes of the mouth appears to be very limited. Under conditions of unusual sensitivity of the mucosa, the stronger agents here discussed may be of some value, but, lacking such conditions, their usefulness is probably much overrated.

CONCLUSIONS

1. In an effort to determine the efficiency of a group of local anesthetic drugs as topical anesthetics in the mouth under conditions of practical application in the clinic, paired solutions were compared by a number of independent operators in "blind tests" on 457 patients. Normal saline and dilute alcohol solutions were included as blank controls for the subjective reactions and for the solvents used for the anesthetics. The control solutions were colored, flavored and aromatized to resemble in appearance the anesthetic solutions.

2. Partial or complete anesthesia was apparently produced to the satisfaction of operator and patient in from 17 to 54 per cent of the cases when only blank control solutions were applied. Alcohol 95 per cent increased the incidence of apparent anesthesia to about 70 per cent of the cases.

3. Butesin 10 per cent, phenol 5 per cent, benzyl alcohol 50 per cent and orthoform 10 per cent produced anesthesia in about 75 per cent of the patients, but caused necrosis or sloughs in from 4 to 9 per cent.

4. Butyn 10 per cent, "butyn topical," cocaine hydrochloride 1 per cent, saligenin 10 per cent, chlorbutanol 10 per cent and benzocaine 10 per cent produced anesthesia in practically all the patients tested. Of the latter solutions, benzocaine was undesirable, since it caused sloughs in 12 per cent of the patients.

5. The anesthesia apparently produced by comparatively innocuous or inert solutions indicates that claims for topical anesthetics in the mouth must be regarded with considerable skepticism. Various psychologic conditions may produce apparently positive results. The low sensitivity of the gum tissues promotes, if anything, the full play of suggestion. Therefore, a real need for topical anesthetics would seem to be limited chiefly to patients with hypersensitive gums or to conditions wherein the need for analgesia is unusually great.

RESEARCH IN LOCAL ANESTHESIA AND ITS CLINICAL APPLICATION*

By STANLEY W. CLARK, D.D.S., M.S.D., LL.B., F.A.C.D., Chicago, Ill.

MORE than six years have passed since the investigation of the alkaline local anesthetic solution was commenced at Northwestern University. From time to time, reports regarding the progress of this work have been published by different members of the staff, and it seems appropriate that another report of this continuous investigation be made now. During these years, the several departments involved in this work, namely, the departments of chemistry, pathology, pharmacology and surgery, have pursued the investigation with the same intense interest that characterized the early efforts in 1929.

Thousands of cases have passed through the oral surgery department and the alkaline local anesthetic solution has been injected in all but a small number of cases, which were used in other approaches to the local anesthetic problem. The success of the local anesthesia employed in connection with this volume of material has served to accentuate the conviction expressed long ago that the alkaline local anesthetic solution represents a most marked improvement as regards efficiency, toxicity and postinjection sequelae, over the commonly used acid local anesthetic solution.

The alkaline local anesthetic solution may be prepared in at least two distinct ways: it may be made of a solution of distilled water and procaine borate to 2 per cent, or it may be prepared from a solution of 0.1 per cent sodium carbonate to which is added procaine hydrochloride to 2 per cent. The two principles involved in the preparation of the alkaline solution suggest an interesting bit of history in connection with the early investigation. These incidents have been reported before, but, in view of the time that has elapsed, it does not seem inappropriate to mention them again. During the investigation of a problem that had no direct relation to the alkaline local anesthetic solution, it was noticed that the solution of procaine borate had a most rapid anesthetic effect on goldfish. The fish were anesthetized by this solution in from fifteen to fifty seconds; whereas, when other goldfish were exposed to the procaine hydrochloride (acid) solution, it required as much as from twenty-five to forty-five minutes to establish anesthesia. While this observation was not original in the laboratories of Northwestern University, it did serve to draw attention to this phenomenon, and it resulted in a broadly planned investigation to determine why procaine borate had such a marked anesthetic effect.

Early conclusions lead to the belief that the apparent increased anesthetic efficiency was due to the alkalinity which naturally resulted when the solution was prepared with the procaine borate. After

*Read before the Section on Oral Surgery, Radiology and Anesthesia at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 19, 1935.

more mature consideration, it occurred to the chemists that perhaps any kind of local anesthetic solution that had an alkalinity comparable to that of the procaine borate might produce a comparable anesthetic efficiency. So, with this thought, a formula was developed by the chemists wherein they introduced 1 gm. of sodium carbonate into 1 liter of distilled water and, with this as a vehicle, prepared a 2 per cent procaine hydrochloride solution. This strength of sodium carbonate was used because it produced an alkalinity of the solution that was practically the same as the alkalinity naturally developed by the use of the procaine borate. This sodium carbonate-procaine hydrochloride solution, to which was added epinephrine 1:30,000, was then extensively employed in the clinics. By "extensively," thousands of cases is meant. To the gratification of all concerned, the anesthesia resulting was as efficacious as that induced by the employment of procaine borate.

From this historical recitation, it will quickly be seen that a different conclusion was necessarily arrived at regarding the cause underlying the increased efficacy. This conclusion was that the use of the procaine borate did not necessarily increase the efficacy, but that the preparation of the anesthetic solution on the alkaline side of the scale had much to do with it. While the cautious chemists will go only part of the way in ascribing the alkalinity of the solution to the increased efficacy, this does seem to the clinician to be a logical explanation. At any rate, it is true clinically that the anesthesia produced by the use of sodium carbonate-procaine hydrochloride solution is just as satisfactory as that produced by the use of procaine borate. A report covering the early investigations was published by Benedict, Freeman and Clark.[1] Anyone interested in this subject will find there a description of the physical, chemical, pharmacologic and clinical aspects of the study.

The clinical results gained from the use of the alkaline local anesthetic solution will be a revelation to the operator who is not familiar with it. While it is necessary to use epinephrine in the usual strength of about 1:30,000 in the solution, the toxic clinical picture so common to the use of the acid procaine hydrochloride-epinephrine solution is almost entirely missing. It is indeed unusual to note any untoward reaction by the patient attending its use. The waiting time in the conduction injections is almost entirely eliminated. The mandibular injection, for instance, induces anesthesia in an average time of less than two minutes, and if the operator consumes a minute or more, as he really should, in making the injection, his patient will be ready for the operation just as soon as the long buccal injection is made in the posterior region, or after less than one minute's wait, if the extracting is done in the anterior region. The same rapid induction with little or no toxic manifestation is characteristic of all conduction injections. As far as the waiting time for anesthesia, or, more properly, the induction period, is concerned, the use of the alkaline local anesthetic solution has reduced it all practically to a basis of immediate operating. This represents a great saving of time to the busy operator. It affords an increased measure of protection to the patient, because this solution has been demonstrated to be less than one-half as toxic as the acid solution, and it has also been convincingly

1. Benedict, H. C.; Clark, S. W., and Freeman, C. W.: Studies in Local Anesthesia, J.A.D.A., 19:2087 (Dec.) 1932.

observed that the surgical field postoperatively is more favorable, with resolution proceeding more rapidly. It should be noted that the duration of anesthesia in the case of the alkaline solution is only about three-fourths that of the acid solution. This is no practical disadvantage, because, in a mandibular injection for example, the duration of anesthesia will extend to fifty minutes or more, and that naturally is time enough for any uneventful operation. There are no other disadvantages to the use of this solution.

In this day, when most dentists are using the stock solution, and that solution is necessarily acid, the preparation of a fresh solution for each patient might be considered a disadvantage. Actually, it consumes no more time to prepare a fresh solution for each case than it does to prepare the hypodermic instrumentarium for the use of the stock solution. If one will develop a simple system of having distilled water handy with some clean test tubes or boiling dishes, together with some sterile syringes and needles, he can actually hurry through the preparation with the consumption of no more time than is required to load the syringe with the carpule or the ampule, provided they too are sterile. In an effort to show this, I have gone through the movements involved in each preparation many times and can state conclusively that the fresh solution can be made ready for use by the operator himself in less than one minute. It takes that much time to get the stock solution ready. Incidentally, the cost of the fresh solution is about one-fifth the cost of the stock solution. This is an important item in the office of the operator who extensively employs local anesthesia.

Procaine borate tablets containing the desired amount of epinephrine can be obtained in the open market. G. D. Searle & Company, Chicago, prepares a procaine borate tablet that has been accepted by the Council on Dental Therapeutics of the American Dental Association. This tablet is made in only one size, of such content that two of them in 5 c.c. of distilled water will make a 2 per cent procaine borate solution with 1:25,000 epinephrine. Sharp & Dohme provides a tablet called borocaine, the content of which is practically the same as the Searle tablet. The borocaine tablet contains epinephrine 1:30,000. All that is required, then, in the preparation of the alkaline local anesthetic solution, is that the operator drop two of these procaine borate tablets uncontaminated into 5 c.c. of distilled water uncontaminated and allow the former to dissolve. The osmotic pressure of this solution is approximately equal to the osmotic pressure of a 0.4 per cent sodium chloride solution. Though this appears to be hypotonic and would suggest the production of an unfavorable tissue response, it does not appear clinically that an unfavorable reaction occurs.

The manufacturers of local anesthetics did not reveal any exaggerated enthusiasm over the alkaline solution in the beginning, for the practical reason that such a solution is not stable. It presents difficulties in preparation and dispensing commercially in ampules and carpules far greater than does the simple acid solution. (The stability of a freshly prepared alkaline local anesthetic solution is between one and two hours.) In all fairness, it can be said that the larger companies have quite generally evinced a desire to improve the anesthetic solution in keeping with the progress of scientific research, and, at the present time, at least one large firm is marketing a prepared solution to meet the improvement embodied in the alkaline solution. This is the novol 75 buffered anesthetic solution, which has been accepted by the Council on Dental Therapeutics of the American Dental Association. A p_H of 6.8 is claimed for

this solution, and though it is still on the acid side (a neutral solution has a p_H of 7.0), it should approximate closely in clinical results the alkaline solution, provided the claimed p_H of 6.8 does not drop down too much before the operator injects it.

It has never been our contention that the use of a stock solution in local anesthesia is contraindicated or inadvisable. Though many operators have preferred, and very likely always will prefer, to use a freshly prepared solution, it is undoubtedly true that if a stock solution is developed wherein all the known advantages exist, there can be no logical scientific reason that it should not be routinely employed. The present trends in research would suggest that such a solution may be developed.

From the time Einhorn discovered novocaine, in 1905, down to a few years ago, not much properly regulated and controlled research was done with the anesthetic solution. Frankly, very little has been accomplished down to the present; but if this important problem is to develop as it must, it will be necessary for qualified institutions and properly trained persons to continue the research. I would make a plea to every person here today and to the dental profession of the country that thought be given to this study so that the time will soon come when there will be available an anesthetic solution which is rapid in action, efficacious, nontoxic and stable, produces sufficiently durable anesthesia and is nonirritating to tissue.

180 North Michigan Avenue.

RELATIONSHIP OF MEDICINE TO DENTISTRY*

By EDGAR V. ALLEN, M.D., Rochester, Minn.

THE physician experienced in examination of the eyes knows that much can be learned from these structures regarding disease in other parts of the body. The ancients regarded the eyes as the "mirror of the soul," but the modern physician has demonstrated in many instances that the eyes are also the mirror of the body, reflecting various pathologic conditions. The small apertures or pupils through which light reaches the nerves of vision are characteristically changed in syphilis of the brain and in poisoning from morphine. When the physician looks through the pupils with a special instrument, he may see evidence of diabetes, chronic interstitial nephritis, high blood pressure, brain tumor, or tuberculosis, or of too many or too few erythrocytes in the blood.

The experienced physician who examines the skin of patients may find evidences of too little secretion from the thyroid gland, of diabetes, tuberculosis, syphilis, leprosy, inadequate diet and diseases of the two little glands that lie over the kidneys.

It is a truism that a physician who makes such observations would render a disservice to the sick if he treated the local condition of the eyes or skin without attempting to correct the underlying sys-

*From the Division of Medicine, The Mayo Clinic.

*Read before the Section on Periodontia at the Seventy-Sixth Annual Session of the American Dental Association, St. Paul, Minn., Aug. 8, 1934.

temic condition. The correct interpretation of the local conditions mentioned has played no small part in elevating the specialties of ophthalmology and dermatology to their rightful place in the care of the sick.

Dentistry should also be an integral part of medicine. In actual practice, they should not be separated any more than, for example, dermatology and medicine. I am not interested here in the controversy regarding education of dentists, but I am interested, as every dentist and physician should be, in the practical and utilitarian cooperation of these two branches of healing. A prime factor in the accomplishment of this is the recognition by dentists that the condition of the teeth frequently reflects the condition of the entire body. When dentists have recognized that the condition of the teeth, gums and jaws may indicate scurvy, anemia, malnutrition, overfunction of the parathyroid glands and similar conditions, they have ceased being mere craftsmen and have become doctors of dentistry. It is too much to expect dentists to diagnose systemic conditions about which they have not been instructed, but it is not too much to expect that they shall recognize that diseases of dental structures may be due to general conditions and not to local conditions alone. In any specific instance, the patient should be referred to a physician to determine the nature of a systemic condition. Nor should the dentist be discouraged by occasional manifestations of disinterest on the part of the physician. He is sometimes peculiarly possessive about what he considers to be his own domain, and he may be reluctant to accept the word of the dentist or unable to find the systemic condition sought.

In addition to purely dental conditions, diseases of structures within the oral cavity may be observed originally by the dentist. It is true that a dentist observing a seriously ill patient with a membrane on a tonsil would call a physician in order that possible diphtheria might be treated promptly; but is cooperation so anxiously sought when the patient is not so seriously ill or when the pathologic condition is not so obvious? It is not so important that the dentist fail to recognize glossitis as a sign of pernicious anemia and ulcer of the tongue as a manifestation of carcinoma as it is for him to recognize that correction of dental disease will not cure such conditions. Failure to recognize this fact may lead to paralysis from the spinal-cord complications of pernicious anemia, or to spread of the carcinoma to an incurable state owing to delay in treatment.

Another pitfall to avoid is acceptance of the word of patients that their ill health is due to dental disease. The laity has great confidence in the extraction of teeth as a cure for diverse maladies. As a result of urging, dentists are sometimes led to extract teeth for conditions that are not produced by dental disease. It is a common belief that the full beneficial effects of extraction of teeth are not manifest for weeks or months. In many instances, this is true; but under circumstances of ill-advised extraction, carcinoma or tuberculosis may make alarming headway, while the dental surgeon and the patient wait hopefully for the anticipated improvement. This point is worthy of emphasis. I am sure that dentists recognize the importance of limiting treatment to diseases which are entirely local, unless they are cooperating with a physician. Thus, they avoid the error of those who hang on the edge of ethical medicine. The chiropractor who, by his own statement, corrects a supposedly dislocated vertebra for a condition recognizable by a physician as tumor of the spinal cord, as an example, is guilty of violation of the confidence of the pa-

tient in him and of obstructing procedures which might lead to cure of the condition.

Before considering the importance of good teeth, it may be of interest to review some of the opinions of a prominent anthropologist, Hooton,[1] regarding these structures:

> Yet our teeth have an illustrious past; they have a serviceable present, and with due conservatism they will continue to perform an indispensable function in the future of man. But if human dentition breaks down, it will carry with it in its fall the human species. The control of future evolution is now in man's own hands—or perhaps rather in his teeth.

If this is true, the dentist is responsible for the future of the human race in no small degree.

It is interesting that teeth decay in the mouth only during life. After death, they become the most nearly imperishable relics of the vertebrate body. For example, if an animal's teeth last until death, they will continue to defy the destructive action of time and the elements, sometimes for millions of years. This observation alone justifies some skepticism regarding the theories of local causes of dental disease.

PERIAPICAL INFECTIONS

There is no doubt that organisms can be disseminated from the teeth to distant points, where they produce disease. A single example serves to illustrate this point. If the germs of a certain ulcerating condition of the bowel are placed in the root canals of the teeth of dogs, these animals develop within a period of from six to eight months a characteristic ulcerating disease comparable in every way to its counterpart in human beings. Similar experiments have been carried out by Hartzell[2] and Rosenow. The general principles of focal infection have been subscribed to by such eminent physicians as C. H. Mayo, Russell Haden and the late John Shaw Billings. Some degree of disrepute has fallen on the tenets of focal infection because of the extravagant claims of its too enthusiastic protagonists. In certain instances, failure of the patient to improve after elimination of periapical infection has led to the belief that the latter procedure is worthless. This is a short-sighted view. There are other foci of infection; namely, the tonsils, prostate gland, uterine cervix and, occasionally, the gallbladder and appendix. Little benefit will result if the sources of infection around the apices of the teeth are eliminated, while infection remains in other areas. In this connection, the dentist should remember that the patient who consults him for elimination of dental infection because of rheumatism, for example, should be referred to a physician for detection of other foci of infection and for general care.

A second explanation of unsatisfactory clinical improvement after the elimination of periapical disease is the advanced stage of the secondary disease. Joints badly injured by infectious arthritis cannot be restored to normal. The pathologic process cannot be reversed and the joints themselves may serve as secondary foci of infection. The prime requisite in the care of all foci of infection resulting or appearing to result in systemic disease is early eradication. It is much better to lock the door before the horse is stolen. Although the principles of focal infection are fairly generally subscribed to, the importance of eradicating dental infection when a systemic disease

1. Hooton, E. A.: Apes, Men and Teeth, Scientific Monthly, 38:24-34 (Jan.) 1934.

2. Hartzell, T. B.: Practical Things Every Dentist Should Know Regarding Treatment of Periodontoclasia, J.A.D.A., 16:1466-1474 (Aug.) 1929.

of possible focal origin does not exist is not ordinarily recognized. Many people never attain buoyant health. As numerous conditions are responsible for this state, the physician should bear in mind that the presence of infected teeth may occasionally be responsible. It would be far better if all foci of infection were eradicated before the patient becomes sick. Doubtless, this procedure would reduce the incidence of certain diseases, but the patient is reluctant to part with teeth apparently causing no trouble, the dentist hesitates to urge their removal and all too often the physician assumes a noncommittal or equivocal attitude. The loss of a few teeth, if they are diseased at the apex, is easily corrected. As long as this is true, hesitancy in eradicating periapical infection, even in the absence of any general systemic disease, impresses one as unwarranted. Any patient should accept gladly the loss of a few teeth if this would possibly aid in avoiding such deadly or incapacitating diseases as bacterial endocarditis or chronic ulcerative colitis.

CARIES

Every physician should be interested in the prevention of caries, which is a health problem. To be sure, caries is not a serious condition, as regards disability, but neither are many other conditions encountered in medicine, such as acne, flat feet or ringworm. They contribute to the general discomfort and unhappiness of the patient. Carious teeth are not only unsightly and at times painful, but they may interfere with proper mastication of food and are potent sources of irritation to the tongue and buccal membranes. In the latter instance, they may contribute to the incidence of malignancy in the oral cavity.

I may remark parenthetically that dentists have done the medical profession a great service in improving the appearance of many persons. Patients, especially adolescent ones, are very apt to develop a feeling of inferiority centering around crooked, crowded, projecting or carious teeth. A corollary to this situation is ordinary acne. The mental distress which results therefrom far outstrips in importance the actual disease, which ordinarily is of little consequence. Prevention or correction of dental deformity eases the patient's mind and contributes to his well-being.

Teeth are very similar to bone, enamel consisting of 95 per cent or more, and dentin of 62 per cent of inorganic salts, chiefly calcium phosphate. Caries is chiefly a process of decalcification or removal of calcium from the teeth. There are three main theories regarding the etiology of caries: (1) the action of acid-producing bacteria, chiefly *Bacillus acidophilus,* (2) the buffer action, alkalinity, salt content and rate of flow of saliva and (3) dietary deficiencies.

I do not want to enter into the controversy regarding the etiology of caries. The predominant evidence strongly suggests a dietary origin. This theory is supported directly and indirectly by observations that unerupted teeth not exposed to the action of bacilli or saliva may become carious; that acid sufficient to cause caries cannot be demonstrated in the saliva; that scrupulous care of the teeth does not prevent caries; that many persons have profuse growths of *Bacillus acidophilus* in the mouth and yet have no caries, and that caries can usually be arrested by a suitable diet, although when this is done, the organisms in the mouth may not change. Another clinical observation of importance is the occurrence of caries during pregnancy. As far as I am aware, there is no change in local conditions at this time; yet caries is very likely to occur. It has been demonstrated

that this condition, which is apparently due to withdrawal by the fetus of calcium and phosphorus from the mother, can be prevented by adequate administration of minerals and vitamins to the expectant mother.

From the experimental and clinical evidence, it is thus quite clear that diet is unquestionably the chief factor in the cause and prevention of caries. Those who are especially interested in this subject are referred to the articles of Arnold,[3] Hawkins,[4] and Boyd, Zentmire and Drain.[5] The last-mentioned investigators have shown that the degree of retention of calcium following ingestion of an adequate diet is highest among children who do not have caries, next highest among those with arrested caries and lowest among those who have active caries. In view of this evidence, it is important for the dentist to have some knowledge of nutrition, in which field he must make some contact with medicine. Each diet should be reinforced with from a pint to a quart of milk, one egg, one or more oranges or tomatoes, an ounce of butter, two or more helpings of succulent vegetables and of fruits, and cod liver oil. Milk supplies the calcium; the fruits contain vitamins B and C, and butter and cod liver oil furnish vitamins A and D, the latter of which is important for the utilization of calcium. When milk is secured with difficulty, some of the calcium salts, such as the tribasic phosphate, can be used. Irradiated ergosterol or haliver oil may be substituted for cod liver oil. I see no reason that every dentist should not instruct patients with caries regarding reinforcement of the diet, provided, of course, the patient is not receiving dietary care for some other condition. The foods prescribed by the dentist as reinforcement of the usual diet can be harmful in no way, and the dentist should manifest no hesitancy in insisting that they constitute a part of the diet of his patients with caries and periodontoclasia.

It should be remembered, of course, that such conditions as hyperthyroidism and hyperparathyroidism may cause decalcification of bone and, eventually, caries. If caries does not respond satisfactorily to dietary and other treatment, the services of a physician should be enlisted in the search for some metabolic disturbance that could be causal.

PERIODONTOCLASIA

Without being too specific about a subject with which I am little familiar, I wish to state that there is considerable evidence that periodontoclasia is in large part a manifestation of systemic deficiency. To be sure, bacteria are very important, as has been demonstrated by Hartzell, but they may gain a foothold secondarily. There exists a rough corollary of this situation in medicine. Scurvy is due to a deficiency of vitamin C. A good description is furnished in John Colbatch's[6] "A Collection of Facts, Surgical and Medical in 1699":

> I have frequently been told by some seamen and surgeons, that having had long voyages at sea, especially toward China and the Indies, that of a hundred men in a ship, not two of them but have been almost eaten up with the scurvy, their skin squalid and full of blotches, their gums eaten away, and their teeth ready to drop out, pains and aches all over their

3. Arnold, D. P.: Diet and Dental Caries, J.A.D.A., 70:1420-1423 (Aug.) 1933.

4. Hawkins, H. F.: Relation of Diet to Dental Caries, J.A.D.A., 21:630-635 (April) 1934.

5. Boyd, J. D.; Zentmire, Zelma, and Drain, C. L.: Bacteriologic Studies in Dental Caries, J. D. Res., 13:443-452 (Dec.) 1933.

6. Colbatch, John: Quoted by Hanke, M. T.: Rôle of Diet in Cause, Prevention and Cure of Dental Caries, J. Nutrition, 3:433-451 (Jan.) 1931.

bodies, and yet on landing at Cadiz, or thereabouts, where is plenty of oranges and lemons, and eating large quantities of them, in one fortnight's time at farthest scarcely one has failed of being perfectly cured. This is not a relation of one or two persons only, but what is generally agreed upon, and allowed by all to be truth.

The essential changes in scurvy are swelling and degeneration of the lining of the small blood vessels, as a result of which the flow of blood is retarded; edema, hemorrhage, and congestion occur, and the tissues are inadequately supplied with oxygen.

There is considerable evidence that periodontoclasia is in certain aspects a mild type of scurvy due to a deficiency of vitamins. Thus, Howe[7] has produced all the dental conditions with which the dentist comes in contact by feeding monkeys diets deficient solely in vitamin C, and Hanke has shown that a diet rich in vitamins, particularly in vitamin C, will not infrequently reduce the thickness of the periodontal membrane and convert spongy or soft gingival tissue into perfectly normal tissue.

Hanke has summarized the relation of diet to dental conditions as follows:

> These considerations justify the conclusion that a deficiency in vitamin C may be a very important factor in producing pathologic changes in the pulp, in the periodontal tissue and the gingival tissue. This immediately throws a new light on dental disease and releases us from the shackles of the rather hopeless outlook that dental caries is a purely chemical process occasioned by products of bacterial fermentation and that spongy gingival tissue and pyorrhea are primarily due to the ravages of bacteria that can hardly be removed from the mouth. It lays stress upon the metabolism of body cells. If we can produce healthy cells by proper nourishment, we can often eliminate the bacteria from the infected areas and keep them outside of the confines of the tissue.

Whether these implications of the relationship of nutrition to dental diseases are wholly or only partly true is of little moment. Every practitioner and specialist in dentistry must have sufficient knowledge of nutrition to outline to his patients a diet adequate in vitamins and minerals. To fail to do so is to disregard an important function of the dentist as a public health officer.

There is a common feeling among physicians, and perhaps they have influenced the dentists in this regard, that pyorrheic tissue is not a focus of infection in general systemic diseases such as arthritis and colitis. That pyorrheic areas are alive with pathogenic bacteria has been conclusively demonstrated by Hartzell and by others, but physicians sometimes feel that it is of little moment because there is "free drainage." I am quite certain that this "free drainage" does not prevent the entrance of bacteria into the general circulation. Particulate matter, such as dyes, can enter the lymphatic vessels of the leg through a superficial scratch on the skin. Monkeys acquire inflammation of the brain from virus dropped in the eye. In these instances, the "drainage" is better than in pyorrhea, yet dyes and viruses gain access to the lymph or blood vessels. Hartzell has shown that there are many pathogenic bacteria in the periodontal tissues. Obviously, then, there is not free drainage, and the bacteria have ready access to the general circulation of the blood or lymph. It is probable, therefore, that pyorrhea is a potent source of infection and, as far as the physician is concerned, should be eradicated for the same reasons that periapical infections are.

7. Howe, P. R.: Quoted by Hanke, Footnote 6.

Associated with pyorrhea, one often sees loss of mineral in the mandible and maxilla, a condition recognized medically as demineralization, osteoporosis, or atrophy of bone. This bone can be restored to normal, for bone which has been dedifferentiated into primitive mesenchyme can be built up into bone again. In general, the formation of normal bone is assured in the presence of adequate calcium, primitive connective tissue and an adequate blood supply. If the blood supply is entirely cut off, calcification does not change. If the blood supply is increased, decalcification occurs. In periodontoclasia, it is probable that an increase in the blood supply results from infection and relative disuse. In the case of fracture of bones, it has long been known that use of the bone as soon as possible after fracture leads to calcification. Minor injury leads to marked demineralization of bone, if the use of the extremity is prohibited; but calcification occurs when the extremity is used in a normal way. Adequate exercise, therefore, is important in periodontoclasia. This implies excessive mastication as a part of treatment; and, accordingly, foods high in roughage are important, in addition to the local treatment recommended by Hartzell.

SUMMARY

Dental disease ordinarily does not result entirely from local conditions. As in diseases of the eye and of the skin, diseases of the teeth and accessory structures of mastication may reflect systemic disease or dietary deficiency. The dentist should, therefore, enlist the services of a physician in the search for systemic disease when such is suspected. He should understand enough about nutrition to prescribe a diet high in the minerals and vitamins necessary in the treatment of caries and periodontoclasia. The dentist should bear in mind that patients seek repair or extraction of teeth for conditions unrelated to dentistry, and he should be on the alert to sense such situations and to cooperate with a physician in the care of the patient. The responsibility of the physician in dental disease is no less important. Caries, periapical infection and periodontoclasia are important in the general condition of the patient. The physician must be on the alert to recognize such conditions and be quick to recommend the treatment of them by the dentist.

Coordinated teamwork by dentist and physician will redound to the credit of both professions and lead to increased service to the patient.

TREATMENT OF TRAUMATIC ULCERS*

By EDWARD C. DOBBS, D.D.S., Baltimore, Md.

THE use of silver nitrate, zinc chloride, phenol and similar medicaments has not proved satisfactory for treating oral ulcers. This may be due to (1) incorrect diagnosis of the cause of the ulcer and (2) the use of one remedy for all types of ulcers.

As the etiology of all oral ulcers is not the same, one remedy cannot be expected to be a cureall. Before an oral ulcer is treated, a diagnosis should be made. This

*From the Department of Pharmacology and Therapeutics, University of Maryland, School of Dentistry.

may be based on a short history of the case, a biopsy, a Wassermann test, a smear or a blood or urine analysis.

It is not the purpose of this article to deal with differential diagnosis of oral ulcers. I shall discuss only one type of oral ulcer, the traumatic, which ocurs on areas of the cheek, gums and tongue subjected to injury by the teeth, the toothbrush or by an artificial denture, etc. The ulcer follows a break in the mucous membrane which permits infection by the oral bacteria. The early lesion is a small papule, which rapidly develops into a vesicle and breaks down into a painful ulcer. The ulcer is round or angular, depressed in the center and covered with a whitish membrane. The margin is not undermined nor is it raised with granulation tissue. There is a surrounding area of inflammation. The degree of pain is greater than the size of the ulcer suggests. There may or may not be a swollen lymph gland in the cervical region. The gland involvement is usually singular, the area being firm, freely movable and painful to the touch. An ulcer in contact with normal mucous membrane does not infect the adjacent tissue; which indicates the necessity for a break in the mucosa before infection takes place. In a healthy patient, the ulcer usually remains small and singular and disappears spontaneously in from one to two weeks. Multiple or large ulcers in healthy patients probably are not traumatic.

The early stages of the ulcer, the papule and vesicle, are usually not painful and for that reason are not so often seen by the physician or dentist. At this time, treatment with antiseptics is efficacious, preventing the ulcer stage. Tincture of iodin is the preparation of choice. The developed ulcer is painful, and it is this symptom that leads the patient to seek treatment.

Experiments were started in this clinic to find a remedy that would immediately alleviate the pain and induce rapid healing of the ulcer. The clinic patients and dental students were used for the experiment. A careful diagnosis was first made to determine the etiology of the ulcer. Those of traumatic origin were treated and records kept of the results. Many of the accepted remedies were tried, with unsatisfactory results. The treatment that was found satisfactory is a simple one, applicable for office treatment but unsatisfactory for home treatment. The area about the ulcer is dried with a cotton pledget and concentrated hydrochloric acid is carefully applied to the ulcer on a small cotton pellet, care being exercised to prevent the caustic drug from touching the adjacent normal tissue. The acid is neutralized immediately with a saturated solution of sodium bicarbonate. For larger ulcers of longer duration, the acid may be left in contact with the infected tissue for thirty seconds before the alkali is applied. There are a few minutes of pain due to the caustic action of the acid, but within an hour all soreness disappears. The ulcer heals in two or three days.

I again emphasize that this treatment is satisfactory for traumatic ulcers only. It may exaggerate the symptoms in all other types of ulcers.

THE SOLAR TEETH

By LAWRENCE PARMLY BROWN, D.D.S., Peekskill, N. Y.

As research in dental history can hardly fail to be expedited by constructive criticism of mistaken and doubtful statements relating to any phase of that history, it may be well to have a brief review of an article by Lilian Lindsay entitled "Influence of the Sun on the Teeth."[1] Such a review seems especially desirable as Mrs. Lindsay is the leading British writer on the history of dentistry, and her statements are likely to be accepted by her readers and followed by dental writers without investigation, which is made more or less difficult by her general lack of detailed documentation.

The title of her article is quite inappropriate, as she deals largely with her own theories on the subject of the solar teeth. But we shall find reasons for concluding that few of her theories are supported by her evidence, which is not always authentic; while, on the other hand, she has failed to present some of the most important evidence that relates to her subject.

In 1930, I published an article on "The Cosmic Teeth," Part II of which was devoted to "Flame Teeth and the Teeth of the Sun."[2] Evidence was there presented that the more or less individualized flames of fire were sometimes viewed as biting teeth, and that such flame-teeth were occasionally alloted to the sun, conceived as having a burning bite, especially in the tropics. Both of these concepts appear transparently enough in connection with the fire god Agni in the Hindu Rig-Veda (1500 B.C.); but this evidence is unknown to Mrs. Lindsay, or ignored by her.

Rig-Veda (trans. of H. H. Wilson):

I, lxxix, 5 & 10: "the blazing Agni . . . whose mouth (glows) with many flames . . . sharp-flaming Agni."

V, vii, 7: "He crops the bare ground strewn (with grass and wood), like an animal grazing, he with a golden beard, with shining teeth."

VII, iii, 4: His light "quickly spreads over the earth, when with his teeth (of flame) he devours his food."

VII, iv, 2: "he, who, bright-toothed, attacks the forest, and quickly devours his abundant food."

VIII, lx, 13: "his sharp jaws are not to be resisted: he is mighty toothed, this son of strength."

X, cxv, 2: "who with flaming tooth devours the forest . . . like a lordly well-fed bull amidst (fresh) pasture."

Agni's golden beard (in V, vii, 7, as quoted) is that of the sun god; and with the solar rays compared to fingers, he is the "golden-handed, golden-jawed" god, "who rises regularly at the close of night" (VI, x, 1), and also "golden-toothed, bright colored, wielding flames like weapons" (V, ii, 3). (In another view in the Rig-Veda, Agni is the lightning god [I, cxliv, 5; VI, vi, 2], evidently because lightning bolts were sometimes recognized as fiery teeth.)[3] The

1. Lindsay, Lilian: J.A.D.A., 21:616 (April) 1934.

2. Brown, L. P.: Open Court, 44 (Jan.-April) 1930, and reprint.

3. Footnote 2, Part III. Lightning Teeth.

Scandinavian sun-god Heimdall (Lord-of-the-home, i.e., the earth) is called Gold-toothed (Gullintani), and is said to have teeth of pure gold (Younger Edda, I, 27).

Mrs. Lindsay, in a somewhat equivocal way, associates the teeth of the Hindu Pushan with the "worship of the tooth as the sun" (p. 617) and, in several places, endeavors to demonstrate that the sun is symbolized by a tooth or the teeth; but there can be little or no doubt that all of these endeavors are based on misapprehensions.

She says: "Even Pushan was supplied with artificial teeth by the Asvins, 'twin

Fig. 1.—Tlaloc, ancient Mexican storm god, with serpent-lightning teeth. (Stone effigy, from E. Seler, Codex Vaticanus B., 1902, p. 107.)

sons of the sun'" (p. 617; compare her "Short History of Dentistry, 1933, p. 10, where she states that it is recorded that the Asvins "gave new teeth to Pushan"). In these statements, she follows J. J. Modi, who says of the ancient Hindu doctors: "That they did supply artificial teeth in those days is certain from the fact of the mention of Asvins having supplied a set of artificial teeth to Pushan"; whereas, he previously said: "It seems that, like medicine, dentistry was at one time practiced by gods, for Asvins, the 'twin sons of the sun,' are reputed to have given new teeth to Pushan."[4] For both statements, Modi refers to page 29 of the "History of Aryan Medical Science," by Thakore Saheb of Gondal. But here we have a comparatively late view of the Pushan myth, as set forth by some Indian medical writers (in the Ayur-Veda, a general term for the native system of medicine and surgery). According to the text to which Modi refers:

"The Asvins [as divine physicians] are reputed to have given new teeth to Poosha [Pushan], new eyes to Bhagdeva, and to have cured Chandramas of consumption. These and many other wonderful cures effected by them, raised them not only in the estimation of their compeers but also of the lord Indra, who became desirous of studying the Ayur Veda, and learnt it from them" (Bhagvat Sinh Jee, *A Short History of Aryan Medical Science,* London, 1896, p. 29, with a reference in the appended Bibliography to the *Ayurvedavijnana* of Kaviraj Vinod Lal Sen, Calcutta, 1887. "Thakore Saheb of Gondal" is Jee's title).

Neither the Asvins nor "new teeth" appear in the earlier accounts of Pushan, which seem to have been variously developed in the course of 3,000 years. Pushan is generally recognized as a sun god, with his name interpreted "Bestower of Prosperity or Nourisher." In the Rig-Veda, we read: "May Pushan bestow the precious wealth. . . . May the toothless [*adantaka*] deity bestow the desired wealth" (IV, xxx, 24). According to the Taittirya Sanhita (a version of the Yajur-Veda), a certain sacrifice was given to Pushan, and "Pushan having eaten it, lost his teeth. The gods said of him, 'He has lost his teeth'" (Kanda II, A. B. Keith's translation, "Veda of the Black Yajus School," 1914, Part I, p. 214). The Satapatha-Brah-

4. Modi, J. J.: Indian D. J., 6:2, 10, 1931.

mana (one of the supplements to the Vedas) states that when Bhaga ate some of the sacrifice, it burnt out or knocked out his eyes (the versions vary), and that when it was tasted by Pushan, it knocked out his teeth; "Hence they say 'Pushan is toothless,' and therefore when they prepare a mess of boiled rice [as a sacrifice] for Pushan, they prepare it from ground rice, as is done for one toothless" (Kanda I, in "Sacred Books of the East," XII, p. 210).

The mythic symbolism of Pushan's teeth becomes quite transparent in the Mahbharata (second century B.C.), according to which great epic the sun god Pushan "goes, having a thousand rays, after warming the earth, to the western mountain at the close of day" (V, clxxix, 39, as quoted by E. W. Hopkins, "Epic Mythology," 1915, p. 83). In the Mahabharata, Pushan's teeth are plucked out or torn out during a storm by the supreme cosmic god (Ruda as identified with Siva), who shortly restores them to Pushan, when the storm is over; and the storm appears to be referred secondarily to a struggle between the worshippers of Ruda-Siva and those of Vishnu, the former finally being victorious. (See H. H. Wilson in a note to his "Vishnu Purana," 1840, p. 61.) Pushan's teeth evidently represent the sun's rays or emanations of light and heat as celestial counterparts of terrestrial flame teeth.

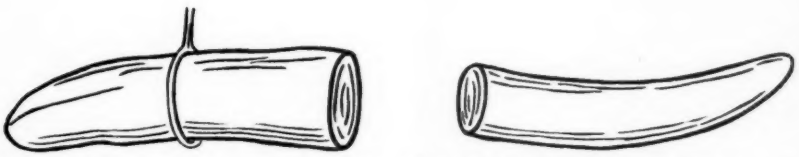

Fig. 2.—Two variant sketches of reputed canine of Buddha at Kandy, Ceylon. Left (tooth hung by string) from Forbes, "Eleven Years in Ceylon," 1841 edition, Vol. 1, p. 292. Right, from Davy, "Account of Interior of Ceylon," 1821, p. 368. The length of the tooth in both sketches is as reported by Forbes.

Mahabharata (trans. of M. N. Dutt):

VII, cciii

51. Mahadeva (Great-god, Ruda-Siva) is not invited to the sacrifice of Daksha, and therefore destroys it.
52. "Shooting an arrow [a lightning bolt] with his bow then, he uttered a tremendous roar [thunder]."
54. "The waters were agitated and the earth trembled."
55. "Enveloped in a pall of gloom, the universe was lost to view."
57, 58. "Then Sankara [Rudra-Siva] smilingly rushed upon Pushan, who was eating the sacrificial oblations, and then tore out his teeth.
59. "Once more Mahadeva aimed at the gods a shower of burning and sharp arrows resembling tongues of fire mixed with smoke or lightning with clouds."
60-62. "Beholding that arrowy shower, all the gods . . . assigned to Rudra a substantial share in sacrifices . . . the great god reëstablished the sacrifice," etc.

X, xviii

16-23. When Daksha's sacrifice was destroyed, "Then the three-eyed Mahadeva, with his bow broke in anger the arms of Savitri [the solar flabelli] and plucked out the eyes of Bhaga [the stars][5] and the teeth of Pushan." Some of the gods fled away, and others fell down senseless. "The gods sought protection of the powerful Mahadeva

5. Brown, L. P.: Cosmic Hands, Open Court, 33:8, 1919; Cosmic Eyes, 32:685, 1918.

and tried to please him. Pleased, the great god threw his anger into the water. . . . He then gave [returned] to Savitri his arms, to Bhaga his eyes and to Pushan his teeth. . . . The world was once more saved."

XIII, clx

14-21. The whole universe was agitated at the twang of Mahadeva's bowstring; the earth trembled, the vault of the sky cracked, and the universe was covered with darkness. The great god first tore out the eyes of Bhaga. "Excited with anger, he attacked Pushan with his foot. He tore out the teeth of that god as he sat employed

Fig. 3.—Bas-relief on stupa of Bharhut, India, second century B. C. (From A. Cunningham, "Stupa of Bharhut," 1879, Plate XXXIII, Fig. 3.)

in eating the large sacrificial ball," etc.

(These concepts undergo further and varied developments in the Linga, Kurma and Bhagavata Puranas. Bhaga has his eyes pulled out, Vahni's hands are cut off, Pushan's teeth are knocked down his throat, etc. See Wilson's "Vishnu Purana," p. 67, footnote.)

(In many modern representations, the solar disk appears as a human face surrounded by emanations of flame, like the teeth of a circular saw; but, in some of the earliest printed books, we find the solar face with wavy flame emanations alternating with straight light rays, single or in groups. In the "Tuppo" Aesop, Vita et Fabulae, Napes, 1485; Torre, Vision Delectable de la Filosofia, Toulouse, 1489; Bernardus, Sermones super Cantica Canticorum, Milan, 1494, and others.)

Of course, there is no inconsistency in the Ayur-Veda view according to which Pushan received "new teeth" (new emanations of light and heat, at the termination of the storm). The restoration of his natural teeth by replantation appears to be indicated in the earlier views, while in the Ayur-Veda it is apparently conceived that he was given new natural teeth by implantation. There seems to be no evidence that artificial teeth were known in India till the twelfth century A.D.[6]

In the extant recension of the Susruta-Samhita (antedating the Christian Era), the sacrifice destroyed by Rudra has the form of the god Yajna, whose head is cut off by Rudra and replaced by the Asvins; and Susruta is there said to have derived his knowledge of medical science from Indra, who had it from the Asvins. But in the Susruta-Samhita, there is nothing of the restoration of Pushan's teeth, Bhaga's eyes or Savitri's arms. (See the translation of A. F. R. Hoernle, 1897, I, 8, and that of K. K. Bhishagratna, 1907, Vol. I, ch. 1, pp. 7 and 8.) Hoernle tells us in a footnote that the Asvins do not appear in any of the older accounts; their introduction seeming to be "an embellishment of the medical *castras,* according to whom the Asvins were induced to undertake the

6. Brown, L. P.: Antiquities of Dental Prosthesis, Part I, D. Cosmos, 76: 835 (Aug.) 1934.

restoration" of the sacrifice (p. 6, note 13). In the Mahabharata, the Asvins restore the sight of the blinded Upamanyu, and say to him: "Your teacher's teeth are black iron, yours will be those of gold" (I, iii, 75, where we seem to have a figurative allusion to the existing poverty of the teacher, and the future wealth of Upamanyu, who became very prosperous; but nevertheless the gold teeth may have been suggested by those of the sun god).

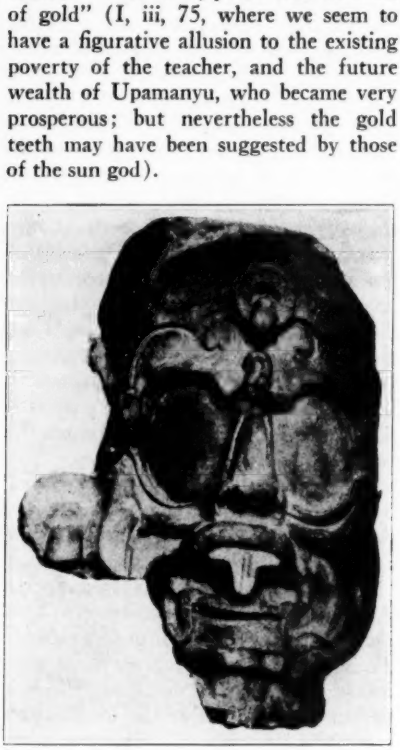

Fig. 4.—Maya sun god with Tau tooth. (Sculpture from Panzamala, Guatemala, in E. P. Dieseldorff, "Kunst und Religion der Mayavolker," I, 1926, Fig. 176.)

As Mrs. Lindsay says, there is a mythic story in the Popol Vuh (of the Quiches of Guatemala), according to which "two youths obtained power over Vakub Cakix and persuaded an aged couple, whose business it was to remove worms from the [carious] teeth, to extract the king's teeth [the broken and aching teeth of Vakub Cakix] and replace them with white maize grains; a story which resembles that of the Asvins and Pushan" (p. 619). Four years before Mrs. Lindsay wrote this, I said, in "Cosmic Teeth": "In the breaking and extraction of the natural teeth of Vakub-Cakix—probably materialized flame teeth—we have some remarkable resemblances to the breaking and knocking out (or tearing out) of the teeth of the Hindu Pushan, which represent the fiery rays of the sun. . . . The grains of maize (seeds of Indian corn) that became the second or substitute (implanted) teeth of Vakub-Cakix were probably conceived as the product of the original maize of the dawn period and the dawn land." (For my interpretation of Vakub-Cakix as a dawn figure, see Part IV of "Cosmic Teeth.") There can be no reasonable doubt that two rows of maize grains are represented by the normal complement of regular teeth given to the Maya maize god Tzultaca.[7]

Mrs. Lindsay accepts Marcel Baudouin's theory that the necklaces of teeth worn by certain savages and semicivilized peoples were originally of simple circular form, but were "later embellished with a pendant representing the sun," and that the number of teeth in these necklaces, "at first ten, then twelve, seems to suggest that they were intended to represent the signs of the zodiac, and the pendant, being the canine, would mean that that tooth was regarded as the sun." (P. 616.) I am familiar with Baudouin's numerous articles published in French dental journals; but I find abundant evidence that nearly all of his astronomico-symbolic theories relating to the teeth are

7. Dieseldorff, E. P.: Kunst und Religion der Mayavolker, 1:12, 1926, Figs. 24, 65, 213 and others.

without foundation in fact; and Mrs. Lindsay does not present Baudouin's fanciful interpretations of the necklaces in question with much accuracy. He considers several necklaces, composed of various numbers of teeth, recognizing one from the Sudan, with twenty-one teeth, as composed of three groups of seven symbols of the seven stars of the Pleiades, while the seventy-five teeth of another, from New Caledonia, are referred to the seven Pleiades, three stars of Orion, etc. In connection with his consideration of the latter necklace,[8] he conjectures that some primitive peoples had zodiacs of eight and ten signs (as well as twelve), for which there is no evidence. Neither is there any evidence that the teeth in the necklaces of any people were "at first ten, then twelve," or that any such necklace represents the circle of the zodiac, or that the pendant canine, which rarely is found, symbolizes the sun.

Fig. 5.—Maya sun god with Tau tooth. (Sculpture from Coban, Guatemala, in E. P. Dieseldorff, "Kunst und Religion der Mayavolker," III, 1933, Fig. 123.)

At the close of her statement that the canine as a pendant "was regarded as the sun," Mrs. Lindsay says: "and this is confirmed by the story of the tooth [of Guatama Buddha] in Kandy in Ceylon" (p. 616). But this celebrated relic is recognized by the Buddhists as one of the four canines of Guatama, which are alloted in some Buddhist works to the north, east, south and west of India, while others allot them respectively to the east, the west, the heaven of the gods in the far north and the habitation of the nagas or demons in the far south (as I have shown in "Cosmic Teeth," Part II). These canines were probably recognized as symbols of the power and sovereignty of Guatama Buddha, in heaven and hell, as well as in the four quarters of India.

Mrs. Lindsay says: "An ancient story found inscribed on a pillar in Pali verse describes a contest . . . for the possession of the tooth [now at Kandy], all the details of which point to the fact that this tooth was regarded as the sun." But the story to which she refers was not found inscribed on a pillar. It is set forth in the Dathavansa (or Dathavamsa), a thirteenth century Pali poem by Dhammakitti Thera, based on a lost Singhalese work of about 300 A.D., by an unknown author. (See "Cosmic Teeth," Part II.) There are two variant English translations of the Pali poem; the first by Mutu Coomara Swamy (1874) and the second by Bimala Charan Law (1925). The four canines of Buddha are mentioned in both translations, but in neither is the Kandy tooth or any of the others ever "regarded as the sun." Only in III, 17, of Law's

8. Baudouin, Marcel: Sem. Dent., 8:681, 1926.

version is the Kandy tooth said to be "like the sun" (as quoted by Lindsay); but this is probably the result of an error of transcription. In the same place, Coomara has "like the moon," and in several verses of both translations the tooth is compared to the moon, or its whiteness or brightness is said to be like that of the moon—apparently the crescent moon, which is viewed as a canine tooth in some myths. (See "Cosmic Teeth," Part I.)

Some of the differences between the two English translations will be seen in the following quotations:

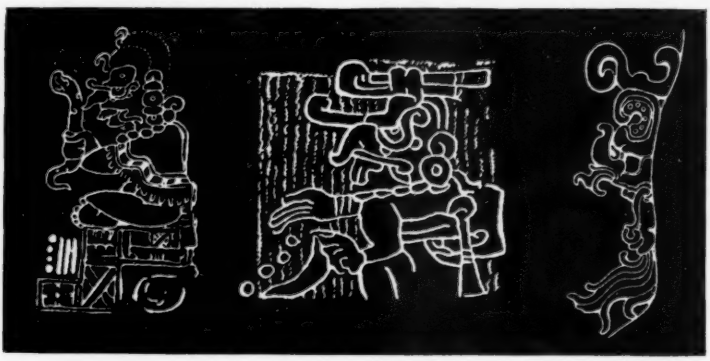

Fig. 6.—Bifurcated tooth of Maya God B. Left, from the Dresden Codex; center, from the Codex Tro-Cortesianus; right, head of God B in conventional ornamentation, from Spinden, "Maya Art," p. 63, Fig. 75.

II, 123. Coomara (Dathavansa): "The tooth-relic, beautiful as the digit [finger, or finger-like form] of the [crescent] moon, ascending the sky, shooting forth silver-white rays." Law (Dathavamsa): "shooting forth rays as white as silver, as beautiful as moon beams."

III, 17. Coomara: "The relic . . . illuminated all directions with its rays, like the moon standing in the eastern mountain." Law: "Like the sun [read moon] shining in the eastern mountain."

III, 53. Coomara: "Let the relic of Buddha ascend instantly to the vault of the skies, shining like the digit of the moon." Law: "Shining like the moon beam."

III, 54. Coomara: It ascended, "illuminating all directions, like the planet Venus [Osadhi, which some Orientalists take for a name of the moon]." Law: "Like the morning star."

III, 58, 59. Coomara: Placed in a bowl of water, "it moved swiftly, as if it were a [white] swan, with its right side upward, rising and sinking." Law: "Like a swan dipping and rising, in the sweet-scented water, turning to the right hand side [as probably suggested by the apparent course of the moon, which is also that of the sun and the stars]."

III, 84. Coomara: With rays "white as the kunda flower." Law: "With lustre white like the white Jesmin."

IV, 51. Coomara: "Ascending to the sky . . . as if it were the digit of the moon . . . emitting rays resembling straight darts of silver." Law: "Like moon beams."

V, 26. Coomara: "With milk-white rays." Law: "With rays as white as milk."

V, 28. Coomara: "Like the moon emerging from the interior of a white cloud." Law: "Like the moon coming out of the white sea."

V, 63. Coomara: "Of a colour like a part

of the moon [the crescent], white as the Kunda flower." Law: "As beautiful as the moon, with rays as white as the Jesmin flower."

(The Pali word that is rendered "sun" by Law, and "moon" by Coomara, is sudhamarici [nectar-rayed-one; i.e., the moon]. The word rendered "moon-beam" by Law, and "digit of the moon" by Coomara, is sudhamsulekha [streak of-the-moon, for the elongated form of the lunar crescent]. In her article on "The Sun, the Toothdrawer and the Saint,"[9] Mrs. Lindsay says that the story under consideration was translated by Turnour in 1836, thus confusing the Dathavamsa [or Dathavansa] with the Mahavamsa. George Turnour's translation of the latter was published in 1837, and while it contains some account of the body relics of Buddha (ch. xxxi), it does not mention his tooth or teeth.)

Fig. 7.—Filed teeth of ancient Maya, from Mountain Cow, British Honduras. (In Field Museum of Natural History, Chicago.)

The reputed tooth of Buddha now at Kandy was seen in 1828 by Major Jon Forbes, who says: "It is a piece of discoloured ivory, slightly curved, nearly two inches in length, and one inch in diameter at the base; from thence to the other extremity, which is rounded and blunt, it considerably decreases in size." ("Eleven Years in Ceylon," Ed. 2, 1841, p. 293, with illustration of the tooth on page 292. Compare the variant and probably less authentic illustration in John Davy's "Account of the Interior of Ceylon," 1821, p. 368.) The great size of the tooth has been referred by some to the early connection of Buddhism and the Yaksha cult in India; for Buddha is sometimes described as a Yaksha (Jatakas, II, 308; IV, 287; Majjhima, I, 292, 386), and the Yakshas, commonly represented with large canines like the tusks of boars, were recognized by some as deities of the earth; whereas, others considered them evil spirits. (See Davy, p. 6.)

Mrs. Lindsay notices that the Tamils (worshipers of Vishnu in Ceylon and southern India, and opponents of the Buddhists) hold that the Kandy relic is a tooth of the monkey god Hanuman, and that one of the avatars of Vishnu is Kapi, the monkey, who produces rain (pp. 617, 621). Hanuman (Large-jawed) as a storm-cloud figure is also a producer of rain; but it does not appear that the teeth of either of these monkeys are given any mythical significance. According to Mrs. Lindsay: "Kapi, the monkey god who spills or produces rain, is the monkey who deprives the sky of its sun, or extracts the teeth from its mouth." In connection with this statement, she says: "An early German print shows monkeys extracting teeth in the market place, and the tooth drawer's constant companion was the monkey"; and she also notes that "the first illustration [i.e., the earliest extant representation] of the operation of extraction, carved on the stupa of Barut [Bharhut], built between 300 and 200 B.C., shows monkeys extracting the left upper cuspid from a giant" (p. 621). In the stupa carving, an elephant does the actual extraction by means of a rope tied to the tooth,[10] and while it is possible that the elephant and the monkeys represent storm clouds,

9. Lindsay, Lilian: Proc. Roy. Soc. Med., 1933, p. 1378.

10. Cunningham, A.: Stupa of Bharhut, 1879, Plate XXXIII, Fig. 3.

with the giant as the sun, there is no evidence that we have here anything but a humorous scene. Monkeys were rarely the companions of toothdrawers, as far as we know; and the German print to which Mrs. Lindsay refers is one of a pair, the other showing monkeys performing several surgical operations in addition to tooth drawing[11]; wherefore there can be little doubt that the monkeys in the German prints were employed simply for comic effect, probably in ridicule of the surgeon and toothdrawer.

Mrs. Lindsay says: "The lines in an old Vedic hymn seem to suggest the destroying aspect of the sun, that of Siva, the destroyer," and she quotes an English translation, or rather, a diffuse paraphrase, of the lines to which she refers (p. 617, with no source reference). The original text is a charm in the Atharva-Veda (IV, vi, 140), the following excerpts from it being according to the close translation of M. Bloomfield (In "Sacred Books of the East," XLII):

"Those two teeth, the tigers, that have broken forth, eager to devour father and mother. . . ."

"Do ye eat rice, eat barley, and eat, too, beans, as well as seamun. That, O teeth, is the share deposited for your enrichment. Do not injure father and mother!"

"Since ye have been invoked, O teeth, be ye in unison kind and propitious: elsewhere, O teeth, shall pass away the fierce (qualities) of your body. Do not injure father and mother!"

Some Sanskrit scholars interpret this text as a charm against danger supposed to be threatened in connection with the pair of deciduous teeth that first erupt, usually the lower central incisors, which often injure the mother's breast; but the statement that solid food is supplied for the development of "the tigers," which are invoked not to injure the father as well as the mother, makes it possible that the charm relates to the first erupting pair of permanent central incisors. Other interpreters refer the charm to the unusual eruption of the deciduous upper central incisors earlier than the lower; the solid food being explained as a magical offering to avert injury or death to the parents as supposed to be threatened by that order of eruption (S.B.E., XLII, p. 540, note), which, in some parts of Africa, Asia and Europe, has long been considered an evil portent to the child or its parents, or both.[12] There is no evidence in support of Mrs. Lindsay's suggestion, although it is true that Siva as the destroyer is sometimes symbolized by the tiger; but that animal (a cat) is generally a lunar figure, while the lion is the chief animal symbol of the sun.

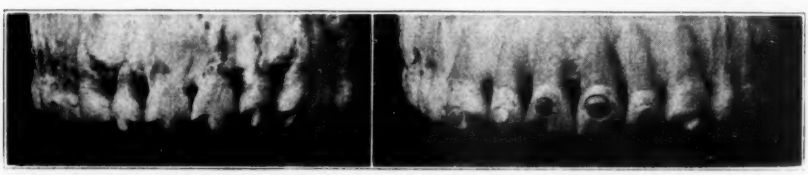

Fig. 8.—Filed teeth of ancient Maya, from San Jose, British Honduras. (In Field Museum of Natural History, Chicago.)

11. Proskauer, C.: Iconographica Odontologica, Plates 26, 27.

12. Kanner, Leo: Folklore of the Teeth, New York City: Macmillan Company, 1928, pp. 13-15; where the charm in question is erroneously referred to the Zend-Avesta.

Neither is there any support for the statement with which Mrs. Lindsay follows her quotation relating to the dental tigers: "This worship of the tooth as the sun would appear to explain the elaborate care of the teeth shown by the ritual observed in the toilet of the mouth of the Hindus" (p. 617).

There is no proof that there ever was any worship of a tooth or teeth as symbolizing the sun, but there are indications that teeth disconnected from the mouth were in some rare instances associated with the sun. Mrs. Lindsay says: "Even today, relics of sun worship exist among us, seen in the custom of throwing children's cast teeth into the fire, and among the Arabs is the custom of throwing shed teeth toward the sun" (p. 622). As Kanner tells us, when one of the Arab boys of former times lost a temporary tooth, he threw it toward the sun, saying, "Give me a better one for it"; and the Kongo negroes do likewise with the first cast tooth of a child, saying to the sun, "If you come back, bring me a new tooth."[12] Thus, it appears that the sun was supposed by some to have the power of giving new and better teeth in place of the deciduous ones; but it is probably that shed teeth thrown into the fire were originally offerings to some fire figure, perhaps conceived with flame teeth, like the Mexican Chantico (In-the-house), the divinity of the domestic hearth. (See "Cosmic Teeth," Part II.)

Mrs. Lindsay suggests that "an association between the teeth and the sun" is indicated by the fact that an eighteenth century British dentist displayed a sign of "The Sun and the Eye," with the motto "Post nublia Phoebus (after a clouded sky, the sun)"; but many similar signs were used in other lines of business, and there is no good reason for supposing that any such association as Mrs. Lindsay suggests is indicated by the sign she mentions. As another conjectural example of the same association, she cites the word Belphegor as one of the "titles" of a toothdrawer, handed down through the centuries and recurring frequently even into our own time (p. 622); and she refers to it elsewhere as "a title much affected by toothdrawers."[9] But there is no evidence that the word was anything but an epithet applied to a toothdrawer (not affected by him), and only very rarely in recent times. Belphegor (or Belphagor) is the Beelphegor of the Septuagint and Vulgate versions of the Old Testament, the Hebrew original being Baal-peor, the name of a Moabite and Midianite god whose worship included licentious rites (Numbers, XXV, 1, etc.). Therefore, it seems that a toothdrawer was called Belphegor by way of opprobrious lampoon, somewhat as in the case of the Ely Cathedral carving of a toothdrawer with a cloven foot, to which Mrs. Lindsay refers (p. 620).

According to Mrs. Lindsay, prehistoric man "invoked the sun for help in dental and oral diseases" (p. 622). But there seems to be no invocation recorded in which either the sun or the sun god is invoked for the cure of these diseases, although the moon is sometimes so invoked,[12] doubtless because of the ancient belief that all things grow or increase while the moon waxes, and decrease while it wanes; whence, a German cure for toothache and other pains is to look toward the waning moon and say, "as the moon decreases, so may my pains decrease also."[13]

In connection with her unsupported statement that the sun was invoked in dental and oral diseases, Mrs. Lindsay says that "medieval man translated the

13. Frazer, J. G.: Adonis, Attis, Osiris, Ed. 9, 1907, p. 377.

sun into a saint [Apollonia] in order to have her intervention when teeth ached" (p. 622). But there is no proof that the virgin martyr Apollonia was ever identified with the sun. Mrs. Lindsay notes that the saint's day in the Roman Catholic calendar is February 9, two days later than the birthday of Apollo, whose festival at this time of the year was called the Apollonia (but only at Sicyon, as far as recorded), and that one of the many chapels dedicated to the saint was built on the site of a temple of Apollo at Rome; but, in these instances, we cannot reasonably assume anything beyond a vague association of the saint with the god, as suggested by the fact that Apollonia signifies "Of Apollo" (i.e., dedicated to Apollo, like the several Greek cities named Apollonia). In the later accounts and representations of her martyrdom, Apollonia has her teeth extracted by means of forceps; but the earlier account, as first found in Eusebius (Historia Ekklesiastike, VI, xli) is as follows:

> But they (the persecutors at Alexandria) also seized the admirable virgin Apollonia, then in advanced years, and beating her jaws, they broke out all her teeth, and kindling a fire before the city, they threatened to burn her alive . . . she suddenly sprang into the fire and was consumed.

Even if a woman named Apollonia did have some (not all) of her teeth knocked out at the time of her martyrdom, it is quite probable that her earlier story was suggested by some lost myth, in which a lunar figure was viewed as an aged virgin who finally descended into the fire of the underworld, after losing her teeth as symbols of the waning moon (in crescent form) during its last seven days. (See "Cosmic Teeth," Part I.) According to one of the later forms of her legend, in the Bollandist *Acta Sanctorum* (February 9), Apollonia's name was originally Dina, (for the virgin Diana, the moon goddess), while that of her father was Apollonius (for Apollon, or Apollo, the sun god).

Mrs. Lindsay supposes that Apollonia's solar character is indicated in a comparatively late Spanish toothache charm, in which the saint is made to say, "I am dying of the pain in my teeth," whereupon the Virgin Mary tells her, "By the bright star Venus, and the setting sun, you shall never have toothache any more."[14] Obviously, there is no more reason for supposing that Apollonia is associated with the setting sun than with Venus in this charm, where she is not identified with either. It is not improbable that both the setting sun and Venus (setting as the evening star) are invoked because they were conceived as able to cure toothache, like the moon when waning.

In support of her futile endeavor to identify Apollonia with the sun, Mrs. Lindsay makes three erroneous statements: "The most ancient inscriptions show that the sun was originally a goddess. In Hebrew, Shemesh, or Samas, is often feminine. The North Semetic male sun god came later" (p. 622). But in ancient India, Egypt, Babylonia, Greece, Rome and northern Europe, the sun and solar personifications have been masculine since the time of the most ancient records. In Hebrew, the usual word for the sun, Shemish, a variant of the Assyrian *semes,* is generally masculine (as in Psalm CIV, 19), but sometimes feminine (as in Genesis, XV, 17) in accordance with the Arabic feminine *sams,* the sun. Nevertheless the personified Sams of the heathen Arabs was a masculine deity (See Encyclopedia Biblica, s. v. Sun).

Mrs. Lindsay says: "Disease of the

14. Footnote 1, p. 622. Footnote 9, p. 1388; compare Footnote 12, p. 174.

teeth has always been regarded as one of the worst ills and attributed to the enemy of the sun, that is, the darkness, personified as the serpent or worm" (p. 617). But the only evidence she presents in connection with the latter part of this statement is the Babylonian "Legend of the Worm," a charm against toothache, which is translated as follows[15]:

After Anu (had created the Heavens)
The Heavens created (the Earth),
The Earth created the marshes,
The marshes created the Worm.
Came the worm and wept before Shamas,
Before Ea came her tears:
"What wilt thou give me for my food,
What wilt thou give me to devour?"
"I will give thee dried bones,
And scented . . . wood."
"What (are) these dried bones of thine to me,
And thy scented . . . wood?
Let me drink among the teeth,
And set me on the gums,
That I may devour the blood of the teeth
And of the gums destroy the strength;
Then shall I hold the bolt of the door.

This is followed by an incantation which the sufferer from toothache is told to say three times: "O Worm: May Ea smite thee with the might of his fist."

Here we appear to have no more than an imagined demonic prototype of the supposed natural tooth worm; but Mrs. Lindsay identifies the worm of the charm with the cosmic Tiamat of Babylonian mythology, who is sometimes figured as a serpent. According to the Babylonian "Creation Epic," the solar Marduk defeats Tiamat and cuts her body into two parts, making the heaven of the upper half and the earth of the lower half.[16] But there is nothing in the charm or elsewhere to indicate that the prototypical tooth worm was an enemy of the sun and had a "Scheme for the conquest of the sun god [Shamas] and for holding him in prison," which Mrs. Lindsay supposes is indicated by the Worm's words relating to the bolt or latch of the door.[17] There can be little or no doubt that "the door" is the mouth into which the Worm asks to be sent.

According to Mrs. Lindsay: "When charms for toothache have been introduced, it is legitimate to assume that the teeth have . . . passed from being the sun to being under the protection of that luminary. All the earliest remedies for toothache bear this out, for they are connected with sun worship" (p. 618); and she adds (p. 619): "The same idea underlies all the plant remedies for toothache." But there seems to be no proof that any remedy was employed for toothache because it was directly or especially connected with sun worship or the sun, although various sun gods are viewed as divine physicians. In support of her statements, Mrs. Lindsay notes the association of the mouse and the lizard with Apollo as with toothache cures and the eruption of the teeth. She interprets Smintheus and Saurokthonus (two of the epithets of Apollo) as Mouse god and Lizard god, respectively; but the latter epithet means Lizard-killer (i.e., Dragon-killer), and while the etmyology and mythical significance of the former is uncertain, it is explained by some ancient writers as Mouse-killer. Regardless of the meaning of these epithets, there can be no reasonable doubt that the mouse was widely associated with the eruption ("cutting") of teeth, and with toothache, simply because of that house rodent's sharp and strong gnawing teeth,

15. Thompson, R. C.: Devils and Evil Spirits of Babylon, 2:161, 1904.

16. Brown, L. P.: Cosmic Man and Homo Signorum, Open Court, 25:21, 1921.

17. Footnote 1, p. 618. Footnote 9, p. 1380.

and the same explanation is probably true of the lizard as representing the mythical dragon. With respect to the several plants which Mrs. Lindsay notes as associated with Apollo and other sun gods as well as being toothache cures, there is no proof that the association is anything but fortuitous, for there are some plants associated with sun gods which are not toothache cures, and vice versa. Kanner gives us a list of 133 plants used for the cure of toothache, and fifty-four animals which have various rôles in the treatment of that malady; but few of them were ever associated with the sun or the sun god.

Mrs. Lindsay finds a solar connotation in an obscure statement from an old Saxon work to which she refers with a slightly erroneous title, and from which she gives a rather inexact quotation. The title of the English version by O. Cockayne is "Leechdoms, Wortcunning and Starcraft of Early England," and the statement in question is rendered as follows by Cockayne (1866, III, p. 103):

> For the teeth . . . this leechcraft is for the human teeth, which the Greeks named *organon,* that is in our language named bliss, since through the teeth, the bliss shall upspring, and man's dignity and all necessity.

As Mrs. Lindsay notes, W. W. Skeat says that the word "bliss" occurs in the Heliand, a Saxon epic poem on the Savior (not in the Saxon Gospels, where Mrs. Lindsay says it is), and Skeat explains this word as allied to "blican," which means "to shine," whence Mrs. Lindsay jumps to the conclusion that the former part of the text in question would read today, "The teeth which are our sun" (p. 621). (Compare "The Sun, the Toothdrawers and the Saint," where she gives her reading as: "the teeth which are our own shining one or our sun.")[18] But there can be little or no doubt that the writer of the "Leechdoms" misunderstood some older statement to the effect that teeth are called the shining ones in Saxon, and in all probability the equivalent Greek word should be *argennon* or *argennos,* the brightwhite (from *argas*), the adjectives most often applied to white teeth by the Greeks.

At the beginning of her article, Mrs. Lindsay quotes from an unnamed writer: "The history of the world, is it not the history of the sun?" And she adds: "This applies to the early history of the teeth. . . . The most deeply rooted desire in the human breast from the beginning of time has been for immortality . . . and the search for an elixir of life which would bestow this condition on him led early man to worship that which appeared to possess this much desired property. This he found in the teeth; for, from the persistence of these organs after the disintegration of the rest of the body . . . these old observers must have argued that the teeth were immortal, and as such were connected with the sun, that symbol of vitality and immortality" (p. 616). There is little in all this that can be accepted, and no evidence whatever for the final statements, which seem to have been suggested by the old Christian belief (to which Mrs. Lindsay does not refer) that it was especially necessary to keep all the bones together in the grave to insure a perfect body in the resurrection.

According to Tertullianus (*ca.* 200 A.D.): "It is certain that not only the bones remain indurated, but also that the teeth continue undecayed for ages; both of them the lasting germs of the body which is to sprout again in the resurrection" (De Resurrectione Carnis,

18. Footnote 9, p. 1384.

XLII); and he also argues that not a tooth nor an eye nor even a single hair shall be wanting when the body is resurrected (XXXV). The Armenians preserve extracted teeth, and hair cut from the head, and hide them in holy places, believing that they will be needed when the dead are raised,[19] and there is an old and widespread belief in Europe that all lost teeth will have to be recovered to make the resurrected body complete, wherefore many people in former times were careful to preserve the teeth lost by extraction or otherwise.[20]

On page 620, Mrs. Lindsay says: "When it is remembered that the teeth were believed to contain a supernatural force conferring on their owner all that is most valuable in life [but there is no evidence for even the supernatural force], it can be understood why, in the earliest codes of law, such severe penalties were exacted from the person, who, by accident or design, deprived another of his teeth—the law of a tooth for a tooth [an amazing statement]. Therefore, the teeth, being held so precious from lingering memory of the time when they had been worshipped as the sun [of which there is no proof], still ruled in man's subconscious mind." This is followed by other statements equally unfounded. Mrs. Lindsay's allusion to "the law of a tooth for a tooth" is misleading, as the ancient laws of retaliatory justice related also to other members of the body. Thus, in the Babylonian Code of Hammarabi, it is ordained that when a man knocks out the tooth of an equal, the latter is to retaliate in kind, but that when the injury is inflicted on a poor man, a third of a mina is to be paid, with similar compensations specified for depriving another of an eye or a hand (Sects. 195-201). The ancient Jewish penalty of a member for a member was at first literally applied among free men ("life for life, eye for eye, tooth for tooth, hand for hand, foot for foot," etc.), while a slave who had an eye or a tooth stricken out by his master was emancipated; but in an early period of Jewish history, money compensation was substituted among free men (Exodus XXI, 12-27; Deuteronomy XIX, 11-21). Of course, the laws of retaliatory justice were based simply on the assumed right of equitable personal vengeance, without any connection with the worship of the sun or any other worship.

While there seems to be no proof that the sun was ever symbolized by a tooth or teeth, we have found convincing evidence that the solar emanations of light and heat were sometimes conceived as teeth; and there are reasons for concluding that this concept appears in a very interesting form in connection with a sun god whom Mrs. Lindsay does not notice, one of the deities of the ancient Maya of Central America and Yucatan.

The Maya sun god is generally known as Kinich Ahu (King of the Day), which is merely his title. His name is Xbalamke or Xbalamquej (sometimes spelled Xbalanque), literally Puma of the Deer, that is to say Destroyer of the Deer, meaning Destroyer of the Stars (at sunrise). He has been identified with God G in the alphabetical pantheon of Paul Shellhas, which god is sometimes shown in the codices with pointed anterior teeth. But the Maya sculptures belong to an earlier period than the codices, and, in the sculptures, the sun god is often figured with abnormally large eyes (for the solar disk in the east and the west), and a so-called Tau tooth (shaped like

19. Frazer, J. G.: Taboo and Perils of the Soul, 1911, p. 280.

20. Quart. Rev. Folklore, 34:343, 1894.

a T) dependent from the middle of the upper alveolar ridge. This dental symbol generally has a vertical mark or groove down the middle, thus apparently representing a double tooth, as shown in Figures 4-5.

In the Maya Codex Tro-Cortesianus, the Tau tooth is given to God B; whereas, in other codices, the symbol has the appearance of a bifurcated tongue. The other symbols of God B indicate that his abode is in the air with the rain, storm clouds and lightning, and he is often associated with the serpent. In all probability, his face is figured like that of the conventionalized serpent of Maya art, with a bifurcated tongue or upper front tooth; and evidence was presented in "Cosmic Teeth" that the mouth symbol of God B was originally the tongue of a serpent, and that it represented a forked lightning bolt. (Part III, reprint, p. 35).

In the Maya sculptures, the mouth symbol of the sun god is sometimes figured like the four upper incisors in one block[21]; while, in other cases, he seems to have a full complement of upper teeth (Dieseldorff, I, fig. 178; compare III, fig. 176, where he shows eight teeth above and eight below); wherefore, it is possible that the Tau tooth originally belonged to God B. But, in the mouth of the sun god, it can hardly represent a lightning bolt.

There seems to be no published interpretation of the sun god's Tau tooth, but the following facts and suggestions have been given to me by Dieseldorff, in a personal communication:

> Regarding the Tooth of the Sun God . . . it is generally called the snake-tooth, as there is a line running down the middle of the tooth, such as exists in the fang of the poisonous snakes. It has also the form of the torn-out eye, to which we give the name of the Tau-eye . . . the orb hanging out of the socket. . . . By the putting out of the eye . . . loss of power is often indicated. The same [Tau] form is used as an expression of the two intercalary days at the end of 13 Katun. . . . As it is a frequent ornament, found everywhere, it refers probably to all intercalary days. . . . When the Tau sign is used for that purpose, the middle line is not expressed [several references to examples]. . . . Still both shapes may come from a common source, as the intercalary days were unlucky; and the tooth of the Sun God may therefore have taken the shape of the torn-out eye, as on intercalary days, when the civil calendar stopped, the Sun naturally was supposed to be without power. . . . As the real snake's tooth does not have the step-like reduction [of the Tau], the form was probably taken from the torn-out eye.

But as the sun god is not represented with the torn-out eye, and as this eye does not always have the Tau form, I venture to suggest that the Tau form represented primarily the bifurcated tongue of a serpent, and secondarily a serpent's fang, in both cases symbolizing a forked lightning bolt descending from the sky; and I also suggest that the symbol was finally employed by the Maya to express the ideas of descent and loss of power as the cause or result of such descent (or fall), the vertical member of the Tau (T) signifying descent, while the horizontal member signifies that from which the descent is made. In this view, the Tau tooth was given to the sun god because his light and heat descends to the earth, while it was made a sign of intercalary days because they belonged to the winter solstice, when the sun descends lowest and becomes weakest in its annual course.

My suggestion that the Tau tooth finally symbolized descent is seemingly confirmed to some extent by the fact that

21. Footnote 7, I, Fig. 177; III, Fig. 124.

the Nahualt (ancient Mexican) word *tlan* signifies below or underneath, as well as a tooth. It appears in *tlanixquactli,* anterior teeth; in *tocoatlan* or *coatlantli,* a cuspid tooth and *tlancoch* or *tlancochtli* or *totlancoch,* a molar tooth. (See Alonso de Molina, *Vocabulario en Lengua Castellana y Mexicana,* 1571 and 1910, s.v. *Diente.*) Among the Nahualt hieroglyphs, *tlan* as a word or syllable is pictured by two or more anterior teeth attached to more or less of the maxillary bone, with one or two vertical grooves on each tooth.[22]

Some Maya human teeth, filed with "step-like" reductions, have been found in British Honduras. It is not improbable that their forms were suggested by the Tau tooth of the sun god, as shown in the accompanying Figures 7-8.

22. Whittlesey, H. G.: History and Development of Dentistry in Mexico, J.A.D.A., 22:989-995 (June) 1935. (In this article there is nothing regarding any symbolic tooth or teeth.)

SOME ASPECTS OF DENTAL ARCH GROWTH*

By SAMUEL J. LEWIS, D.D.S., Detroit, Mich.

IN most treatises on growth, the nature and course of major trends, rather than minor fluctuations, are considered. While major trends are of course important, minor fluctuations are likely to be of greater practical interest to the orthodontist, who is interested in the individual case.

It is only within the last decade or two that the quantitative study of dental arch growth began. It is true that important discoveries were made by earlier investigators through repeated clinical examinations, but today simple observational methods do not suffice. Precise methods of collecting and measuring data must be instituted, and the data thus gathered must be submitted to modern methods of graphic and statistical analysis.

Unlike increases in height and weight, dental arch growth is a very complicated procedure. Increase in stature may be expressed in mass units and curves drawn showing quite accurately the changes that occur at different age levels; but, in the dental arch, new factors appear, along with dimensional increases. The deciduous teeth are shed, the permanent teeth erupt and the complex occlusal adjustments of the permanent teeth are made. All these factors tend to obscure the quantitative picture of growth. For instance, in determining growth increases in the dental arch, we measure between certain teeth, using special anatomic landmarks. These landmarks may not be fixed points, since the teeth may change their position during growth. Accordingly, we are not truly measuring bone increment, but rather increases as affected by dental occlusion, and so special methods of description are required. Further, certain modifying factors in the growth picture may appear, such as premature loss or too long retention of the deciduous teeth, the absence of teeth and the presence of supernumerary teeth, such habits as thumbsucking, variations in the man-

*Read before the Section on Orthodontia at the Seventy-First Annual Midwinter Clinic of the Chicago Dental Society, Feb. 19, 1935.

*Material for this paper was gathered through the cooperation of the Merrill-Palmer School by means of a grant from the Children's Fund of Michigan.

ner, time and sequence of the eruption of the permanent teeth and probably other factors still to be discovered. Thus, a simple curve of dental arch growth, expressing increases in mass units, means little unless certain developmental phenomena are considered in relation to these changes.

It is impossible to consider here the entire subject of dental arch growth. I shall confine my discussion largely to width changes, with special reference to the anterior segment of the mandibular and maxillary arches.

It is generally agreed among workers in this field that approximately five sixths of the mature width of the dental arch has been attained by the age of 4½ years, and also that intercuspid growth is conditioned by factors unrelated to arch increase in the palatal region. The cuspids are contained in the anterior horns of the maxillae, and these are separated from the premaxilla by a suture, which, in the human being, exists as late as 9 years of age. The great amount of vascularity present in young children in these areas indicates that active bone growth is taking place. There is not so much vascularity in the palatal portion of the maxilla. The permanent incisors and cuspids are much larger than their deciduous predecessors, and so a much larger arc is required to receive them. Accordingly,

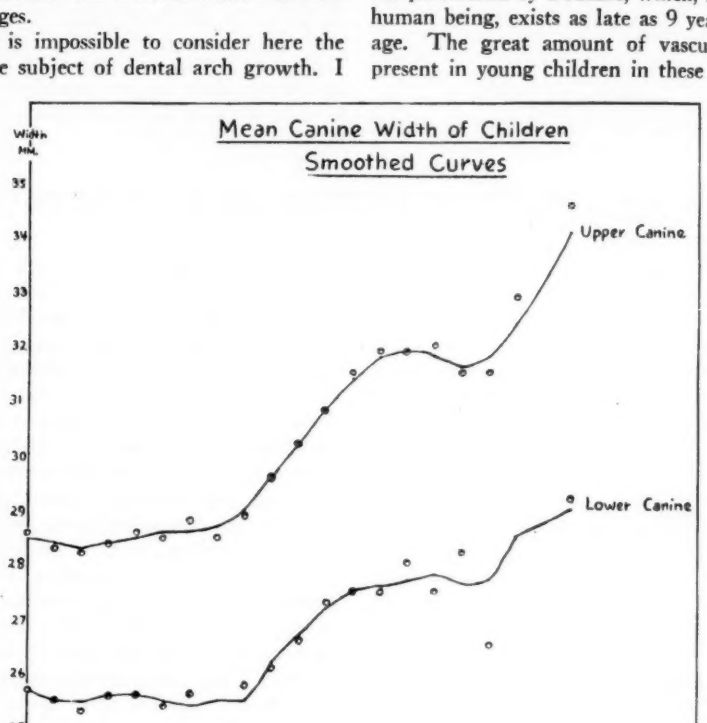

Fig. 1.—Smoothed curve of intercuspid growth.

sufficient intercuspid growth must take place to enlarge the arc for the reception of these teeth. The anterior horns therefore grow rapidly at certain stages, carrying with them the contained teeth. There is a concomitant growth in the mandible, but less in amount, because there is less difference between the size of the deciduous and that of the permanent teeth in this segment.

If we examine the smoothed curve of intercuspid growth in Figure 1, we note

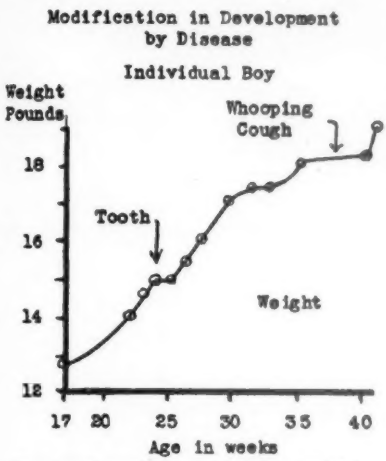

Fig. 2.—Growth curve showing modifying influences. (Courtesy S. A. Courtis.)

that between 2 and 6 years there is a definite plateau in the growth process, that is, a period of quiescence. At 6 years of age, the curves for both the maxilla and the mandible show the beginning of an acceleration of growth, reaching a maximum at 9 years. This is a second maturation point, the first occurring when the deciduous denture is complete. Between 9 and 10½ years, there is another plateau, followed by another spurt, which reaches its maximum at about 13 years. These curves may be said to represent the typical course of intercuspid growth in man, and as such may be used as a yardstick in appraising the normality of growth in these areas.

This curve represents the nature and course of major trends. It does not show individual variations or the conditions that may affect the typical course of growth. For instance, the graph shows that an acceleration of growth begins at 6 years, but it does not tell us that this acceleration is greater in amount in some persons and that it does not always occur at the same age. It represents only increases in dimensions. It does not take into account the complex developmental phenomena that accompany these increases. Except as a standard for comparison, therefore, it has little practical value. Figure 2, showing a boy's weight curve, illustrates the modification in growth brought about by other conditions. Here, there is a period of quiescence during the eruption of a tooth, followed by an increase. Whoopingcough again affects the weight adversely.

Now let us examine some individual curves of intercuspid growth: Figure 3 shows the graph of a case in a girl who has experienced premature loss of some posterior teeth. In the maxilla, there is a spurt of growth starting at 5 years of age and reaching its maximum at 8 years. At this time, the deciduous teeth are being shed and the permanent incisors are erupting. At 8 years, the four permanent incisors are fully erupted, and a period of quiescence follows. At 9½ years, the permanent cuspids start to erupt, and, at 12, they are fully erupted; yet there is no apparent dimensional increase during this period. The total dimensional increase is 6 mm., and the occlusion in the anterior segment is quite normal. As you will see later, one lateral segment is affected by the premature loss of the maxillary molar, but this loss did not modify growth in the anterior segment. In the

Fig. 4.—Anterior view of models from which curve in Figure 3 was plotted.

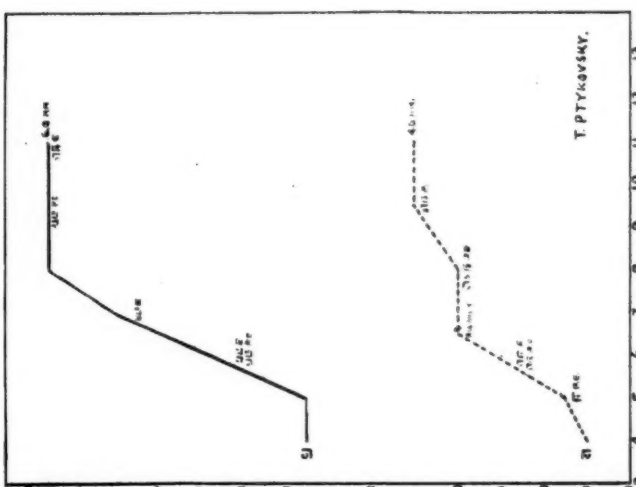

Fig. 3.—Intercuspid growth curve showing appearance of developmental factors.

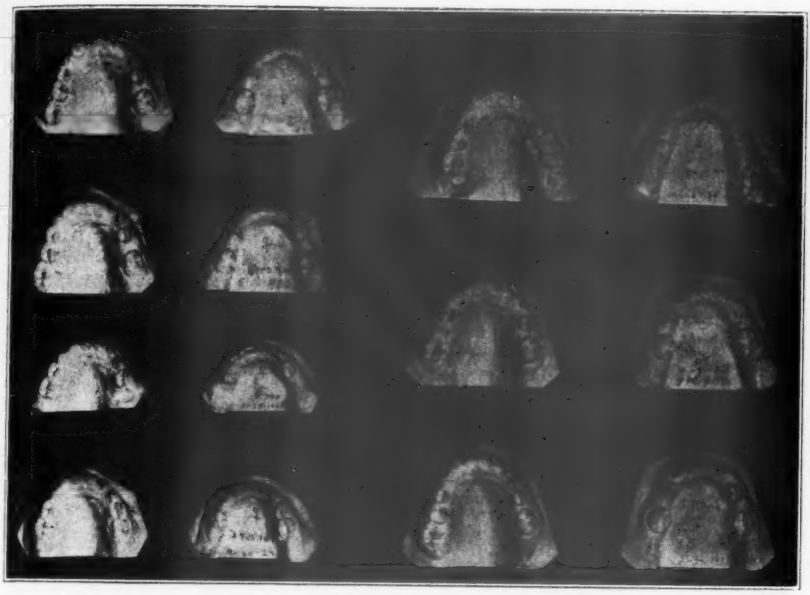

Fig. 5.—Occlusal view of models in Figure 4, showing bicuspid misplaced as result of premature loss of maxillary second molar.

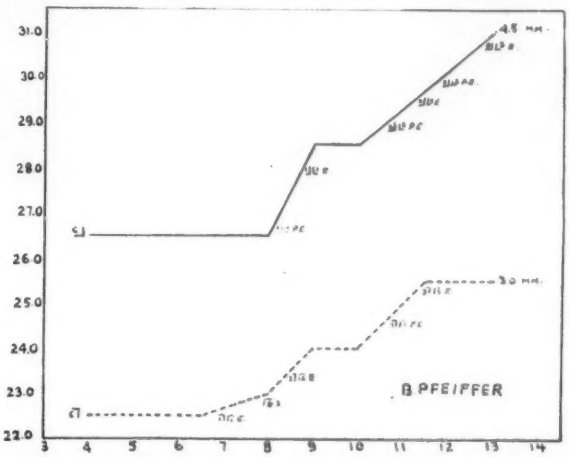

Fig. 6.—Intercuspid growth curve of Class II, Division 1 malocclusion.

mandible, the acceleration period starts at 4 years, and, when the permanent central incisors appear at 5 years, there is a decided spurt, reaching its maximum at 6½

years, or at the time when all four incisors are erupted. Between 6½ and 8 years, there is a period of quiescence. When the permanent cuspids appear, there is another spurt, reaching its maximum at 9½ years, when these teeth are fully erupted. The difference in the two curves during the eruption of the cuspids can be accounted for on the basis of the earlier eruption of the mandibular cuspids, which are fully erupted when the maxillary cuspids start to erupt. As the maxillary cuspids erupt, they adjust themselves to the occlusion of the fully erupted mandibular teeth without any dimensional increase taking place. Thus, the full eruption of the mandibular cuspids at a rather early age seems to have modified the maxillary curve during the eruption of the cuspid teeth. Figure 4 shows the excellent occlusion in the anterior segment of this case. Figure 5 shows the occlusal view. It will be noted that prior to and during the eruption of the permanent incisors, there is no spacing of the deciduous incisors, yet the alinement and occlusion of these teeth are normal. This is not true in the lateral segment, where the loss of the molar has brought about a closure of the space and, as a result, the crowding out of the second bicuspid.

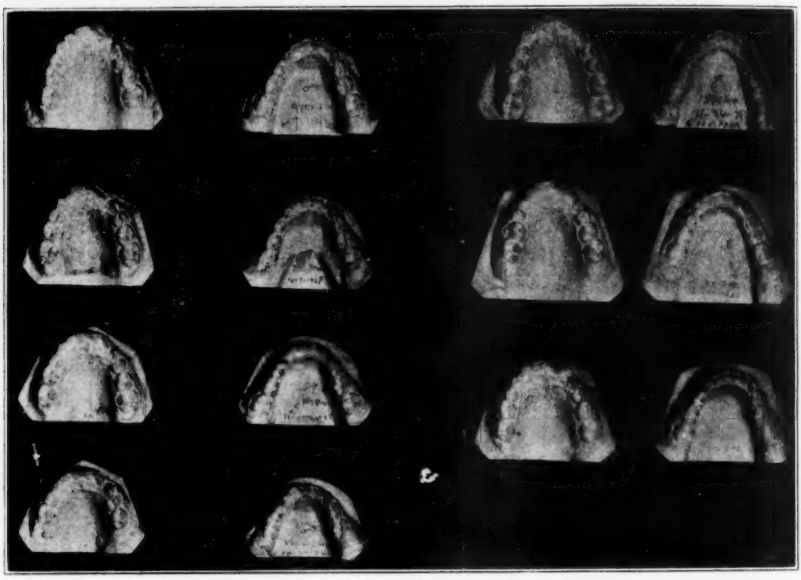

Fig. 7.—Occlusal view of models from which curve in Figure 6 was plotted. There is good alinement of the incisors, without the appearance of incisor spacing; also, spontaneous closure of the diastema between the maxillary incisors.

Figure 6 shows the case of a boy with a Class II, Division 1 malocclusion. In the maxilla, the acceleration period begins at 7 years 9 months, when the central incisors start to erupt. A maximum is reached when these teeth are fully erupted, at 9 years. Between 9 and 10 years, there is a period of quiescence, with

no further teeth appearing. At about 10 years, the deciduous lateral incisors are shed and the permanent lateral incisors start to erupt. A second spurt begins, continuing until, at 13 years, all of the permanent teeth of the anterior segment are fully erupted. Here, we find a different picture from that in the first curve. In the mandible, the first spurt begins at 6½ years, and, in the short period of six months, the central incisors are fully erupted. At 8 years, one deciduous lateral incisor has been shed and by 9 years, both lateral incisors are fully erupted. The first maximum is reached at 9 years. Then, between 9 and 10, there is a period of quiescence, as in the maxilla. At about this time, the permanent cuspids start to erupt and another spurt begins, reaching its maximum at 11½ years, when they are fully erupted. Now why, in this case, do we have dimensional increases in both elements during the eruption of the permanent cuspids, while, in the former case, only the mandibular dimensions increased? In both cases, the mandibular cuspids were fully erupted before the maxillary ones were, though, in the first case, they erupted two and one-half years earlier, and, in the second case, one and one-half years earlier. In the first case, the arch relation is normal, and there was an occlusal adjustment between the teeth of the opposing arches. In the second case, there is a distal relation between the arches, and the occlusal contact between the anterior teeth of the opposing arches is lacking. The cuspids are hardly in occlusion. Figure 7 shows the occlusal views of this case.

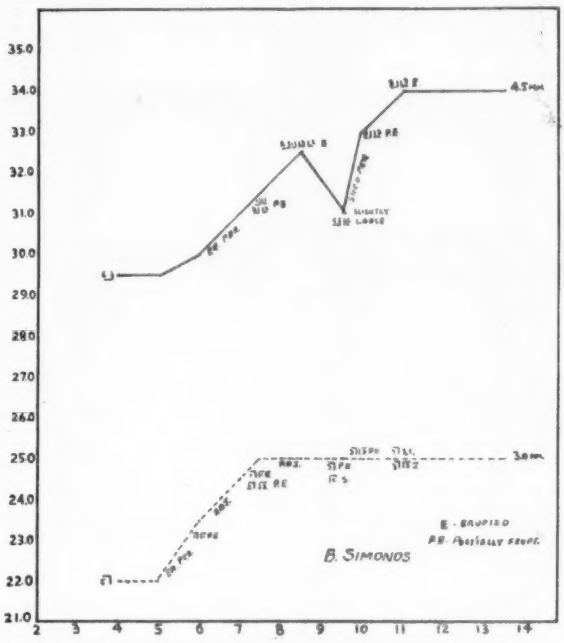

Fig. 8.—Intercuspid growth curve in normal occlusion case.

Now let us look at a normal occlusion case. (Fig. 8.) As in the other cases, the first spurt begins during the eruption of the permanent incisors, but, unlike the former cases, the mandibular and maxillary spurts begin at the same age, 5 years. The maximum of the spurt in growth in the maxilla is reached by 8½, when all the permanent incisors are fully erupted; while, in the mandible, it is reached by 7½, or just before the full eruption of the incisor teeth. A peculiar thing happens in the maxilla between 8½ and 9½ years. There is a decided dip in the curve, or an apparent dimensional decrease. Here, then, a modifying condition arises. We know that there can be no dimensional decrease during growth, except as it affects soft tissues. Something has obscured the growth picture. A close examination of the models reveals a rather large buccal protrusion of the permanent cuspid crypts. As these teeth move toward eruption, they force the deciduous cuspids to seek some sort of occlusion with the erupting mandibular cuspids. In seeking this occlusion, the cuspids actually move in toward each other, and the distance between the points measured actually decreases. This curve is not, therefore, a true picture of arch growth, but rather of occlusal change.

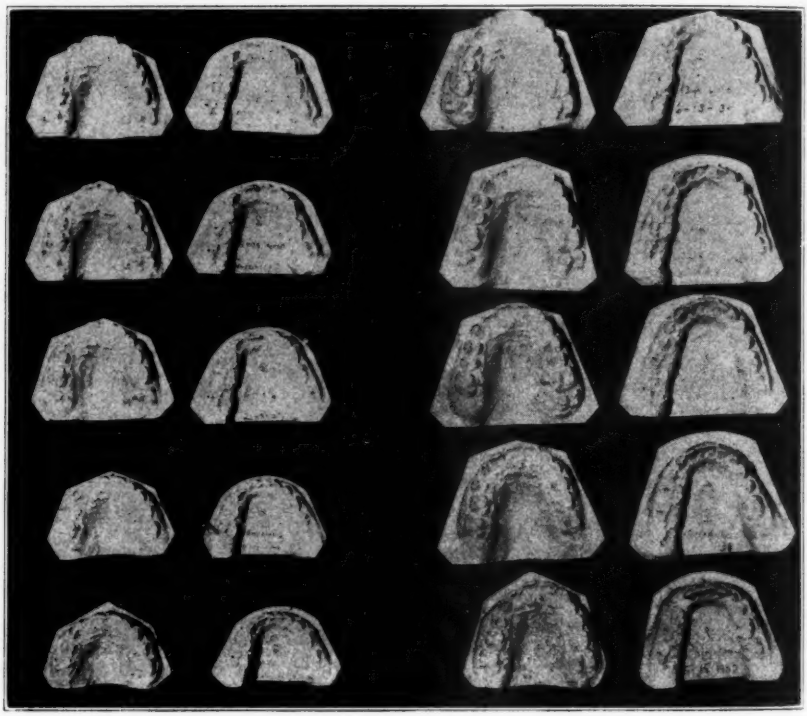

Fig. 9.—Occlusal view of models from which curve in Figure 8 was plotted.

As soon as the maxillary cuspids start to erupt, there is a decided spurt in growth, reaching its maximum at 11 years. From then on, there is no further dimensional increase, for these teeth are fully erupted. Figure 9 shows the occlusal view of the case. There is a slight irregularity of one mandibular lateral incisor, but as far as functional activity is concerned, the occlusion is quite normal. It is interesting to note that no incisor spacing occured, yet alinement and occlusion of the incisors are entirely normal.

Figure 10 illustrates another type of intercuspid growth. In this case, there are four deciduous mandibular incisors, but only three permanent ones. With the exception of a slight dip in the curve between 9 and 10½ years, there is no dimensional change. How may this be explained? The combined diameters of the four deciduous incisors amount to 17.0 mm., and those of the three permanent incisors also amount to 17.0 mm. Thus, there was no need for increased space to accommodate more material than was present in the deciduous arch, and so no intercuspid growth occurred. Thus, another type of modifying condition appears in this case.

Another type of variation in intercuspid growth is illustrated in Figure 11. The girls are identical twins, and occlusion and growth are parallel in type in the two. There is the usual spurt of growth during the eruption of the incisors, but there is a decided dip in the mandibular curve between 9½ and 11½ years. Something has occurred to modify these curves. If we examine the occlusal views (Fig. 12), it will be noted that the permanent cuspids are rotated. In this particular case, the points of measurement are brought closer together as a re-

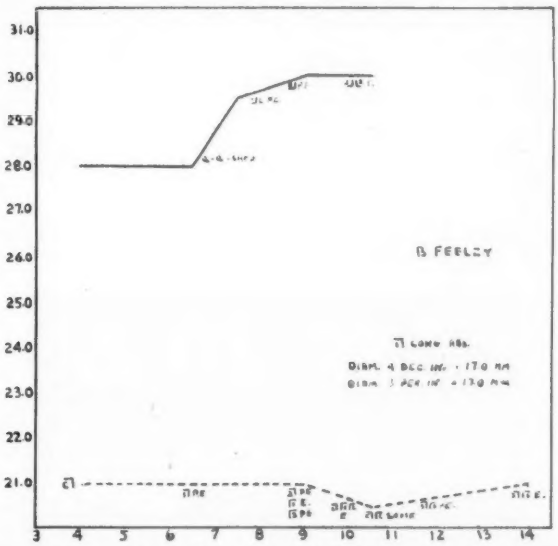

Fig. 10.—Intercuspid growth curve in case in which there is congenital absence of lower incisor. There is a lack of increase of intercuspid space in the mandible.

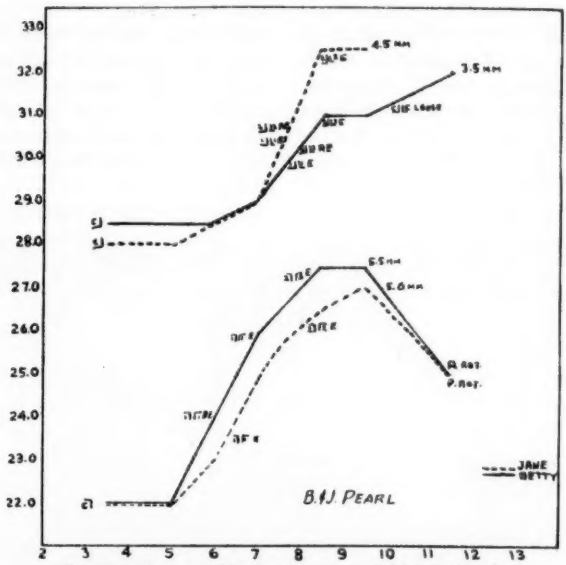

Fig. 11.—Intercuspid growth curve of identical twins.

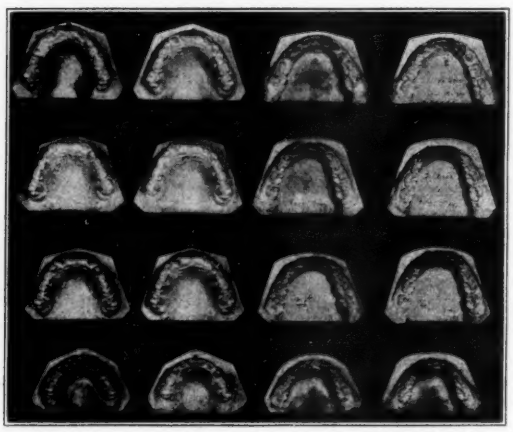

Fig. 12.—Occlusal views of dentures of identical twins. There is a lack of incisor spacing, yet excellent alinement of the permanent incisors.

sult of the rotations. That is, there is no actual dimensional decrease. It will be noted that the occlusion of these twins (Fig. 13) is almost identical. The mirror image observed in certain pairs of identical twins does not appear.

What might happen in a case wherein the permanent incisors were quite irregu-

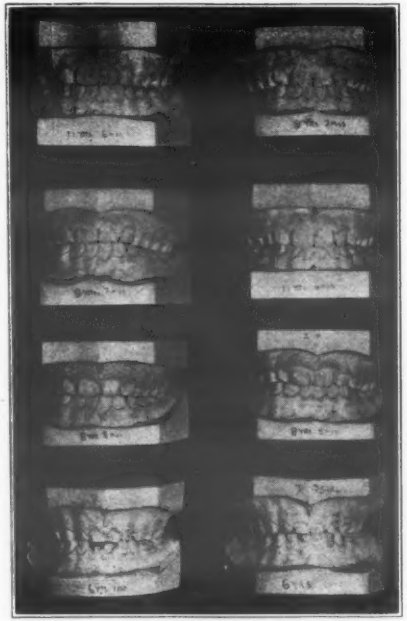

Fig. 13.—Anterior view of dentures of identical twins. The similarity in occlusion and the lack of mirror imaging often seen in monochorionic twins are evident.

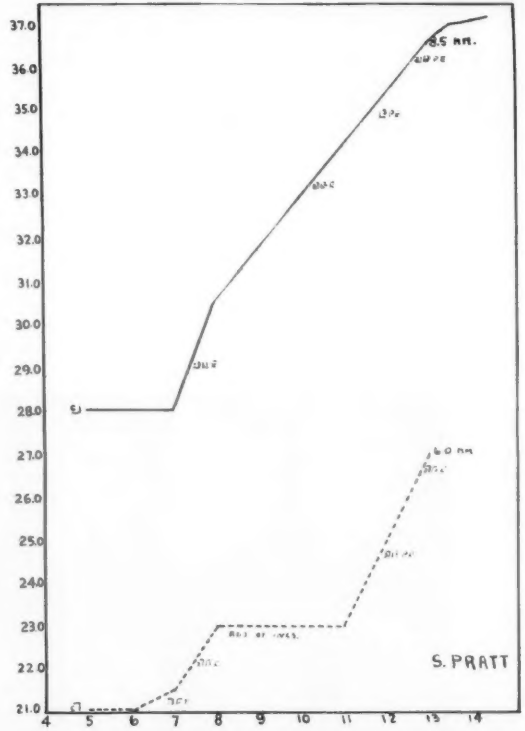

Fig. 14.—Intercuspid growth curve of Class I malocclusion with irregularity of incisors.

lar interested me, but in the present series I could not find an irregularity as marked as I should have liked. Figure 14 shows quite an interesting irregularity, illustrating a point that I have made in previous papers. In the maxillary element, the spurt starts at 7 years, when the permanent incisors are erupting, and continues steadily until 13 years, when the permanent cuspids are about two-thirds erupted. There is an unusually large amount of dimensional increase, 8.5 mm., but still the incisors are irregular. In the mandible, the spurt begins at 6 years, during the eruption of the central incisors. This acceleration continues until 8 years, when all four incisors are fully erupted. Unlike the course in the maxillary curve, there is a period of quiescence between 8 and 11 years, and it is during this period that some adjustment in alinement occurs. At 11 years, another spurt begins, and, during the eruption of the permanent cuspids, there is a steady growth until, at 13, these teeth are fully erupted. Here again, there is a large amount of dimensional increase, 6.0 mm., but still the incisors are quite irregular. In other words, we have sufficient dimensional increase to accommodate the increase in tooth material, but no adjustment in their alinement or occlusion. Figure 15 shows the occlusal views of this case.

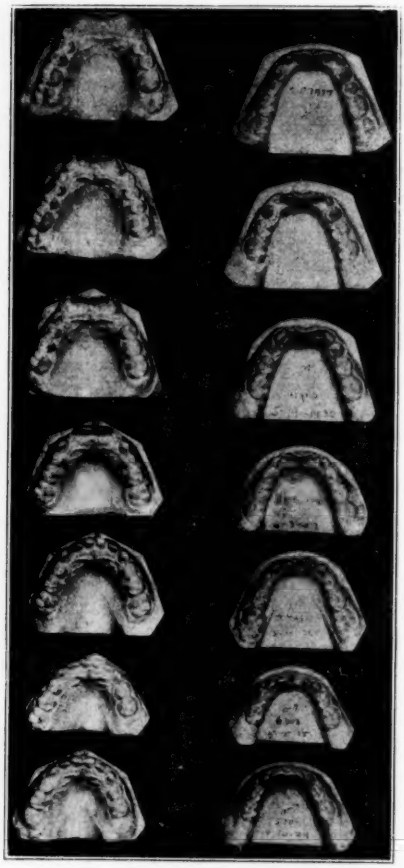

Fig. 15.—Occlusal view of models from which curve in Figure 14 was plotted.

After studying many curves of growth, I became interested in finding out whether all normal occlusion cases followed a certain pattern of growth. Figure 16 is a composite of four maxillary intercuspid curves, all of which were represented by normal occlusion in the final models. All show an initial spurt during the eruption of the permanent incisors, but there are differences in the ages at which growth takes place and in the pattern of growth. These curves seem to show conclusively that normal occlusion may be reached by devious paths, and that some of the variations are due to changes in occlusal adjustment rather than to direct dimensional increase.

To test the similarity of the curves in Figure 16, a Class I malocclusion case, a Class II case and a normal occlusion case were placed on one graph. (Fig. 17.) Here again, we find the usual acceleration period during the eruption of the perma-

nent teeth in all three cases. In the maxillary element, the Class I and II curves show almost the same growth pattern, and, in the mandibular element, the normal and Class II curves are the same. These curves are certainly influenced by eruption.

From the study of many such growth curves, certain conclusions may be drawn, some decisive, others tentative:

1. Intercuspid growth is coincident with the eruption of the permanent incisors and cuspids. There is one period of accelerated growth beginning during the eruption of the incisors; and a second, but not invariable, period of accelerated growth begins during the eruption of the cuspids.

2. The amount of dimensional increase is conditioned by an increase in the amount of tooth material in the permanent series.

3. The pattern of growth may be modified by various developmental factors, especially by the occlusal adjustments that occur as the permanent teeth take their places in the arch. Some of these factors are known; probably others are yet to be discovered. In some cases, we can so influence these factors as to maintain proper growth and adjustment. In others, we can do nothing, but the course of natural processes may result in a normal adjustment.

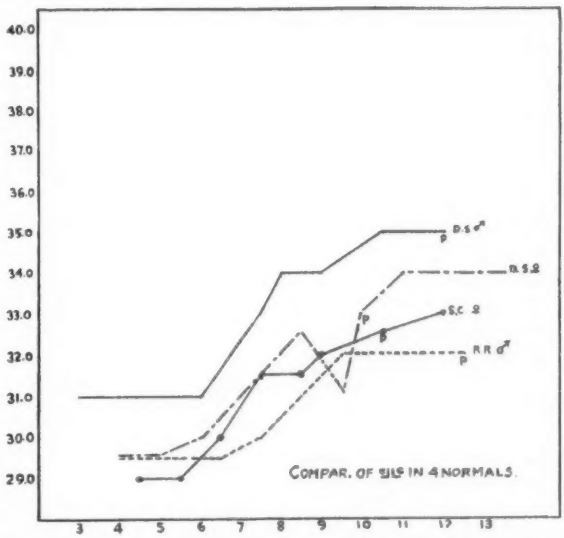

Fig. 16.—Composite graph of four intercuspid curves of normal occlusion showing different patterns.

4. The essential factor in good alinement and occlusion of the permanent teeth of the anterior segment of the arches is not the occurrence of deciduous incisor spacing before the eruption of the permanent incisors, but growth adjustments during or after eruption.

5. Adjustment in alinement and occlusion usually, if not necessarily, takes place during a period of quiescence in growth.

6. In the great majority of cases, the mandibular teeth erupt earlier than the maxillary teeth, and furnish the form or pattern over which the maxillary element is adjusted; whence arises the necessity of maintaining a normal mesiodistal arch relation.

There were the usual spurts of growth during the eruption of the permanent teeth, but most interesting of all is the beautiful adjustment produced by Nature in her effort to build a normal denture. Most of this adjustment took place during a period of quiescence in dimensional

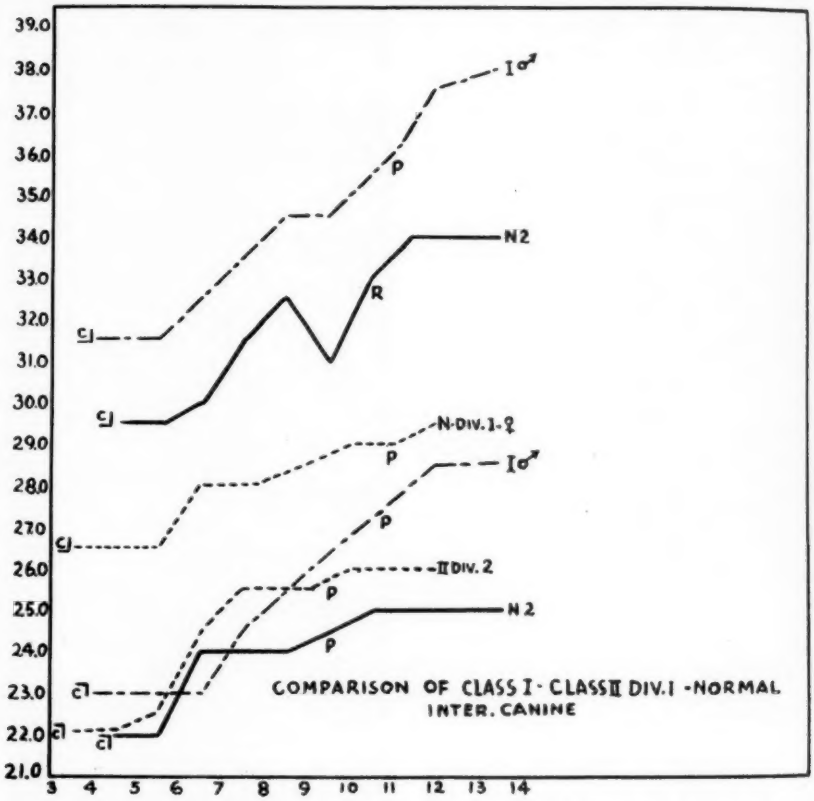

Fig. 17.—Composite curves of normal occlusion and Class I and Class II, Division 1, malocclusion.

To illustrate the natural processes by which normal adjustment is brought about in cases wherein the pattern of occlusion has deviated from the normal, let us consider the case shown in Figure 18.

growth. The deciduous denture, as you will see, was quite normal. At 7 years, there was an apparent malocclusion, shown by the malalinement of the incisors. At 7 years 10 months, there is

some improvement apparent in the alinement and occlusion of the incisors, and, by 11 years 6 months, further adjustment has taken place, the occlusion being practically normal, at least as far as functional activity is concerned. This case, I believe, answers the question propounded by Martin Dewey in an editorial written some years ago: "Is malocclusion ever corrected spontaneously?" He did not believe that it was. In the light of what took place in this case, I leave the answer to you.

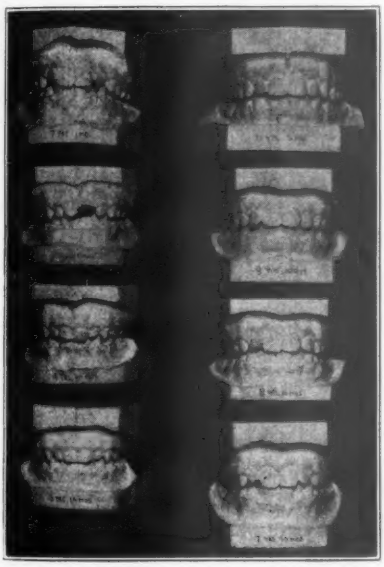

Fig. 18.—Anterior view of case in which spontaneous correction of malocclusion took place during growth period.

I have said that certain modifying conditions that we have observed are amenable to treatment by the orthodontist, and that others are not. Among those that are amenable to treatment, and perhaps one of the most important of these, is the premature loss of certain teeth of the anterior segment.

First of all, we should attempt to clear up the matter of what constitutes the premature loss of a deciduous tooth. We may say that a deciduous tooth is lost prematurely when, for some reason or other, it is lost before the normal shedding time. Thus, we should base our judgment of premature loss on a knowledge of the normal shedding period of the deciduous teeth. On this subject, I have found only one important study in the literature.[1] Spier published a study in 1918, but he had studied boys only; hence, the greater importance of Hellman's work. Figure 19 shows the results of Hellman's studies. You will note that besides giving the average time for shedding in both girls and boys in the wealthy and the poor, he also records the standard deviations. Thus, by subtracting or adding the standard deviations, we arrive at the range of normal variation as a basis for judging premature loss or too long retention. Further studies should be made, for I am of the opinion that Hellman's chart needs some revision in certain items. In any event, he has given us a yardstick, which too few of us have made use of.

Among the etiologic factors usually named in premature loss are caries sequelae and accidents. Perhaps the large majority of losses are incurred in this way, but there are also other factors. One I shall discuss. It is a common experience of the orthodontist to find a certain type of malocclusion associated with the premature loss of one mandibular deciduous cuspid, as shown in Figure 20. I have recently gone over my records and have found twenty-one such cases that were presented during the last three years. Unfortunately, the orthodonist does not see them until the tooth is lost and the damage is done. When he does

1. Hellman, Milo: D. Cosmos, 65:1329 (Dec.) 1923.

see them, he usually tries to find out whether the tooth was lost through disease or accident, and, in most cases, the mother is rather vague about the history. Such studies as I have made at the Merrill-Palmer School and in my own practice have shed some light on this particular problem. In the upper part of Figure 21 may be seen the result of such a case over a period of one and one-half years. In the first model, the cuspids are both present, the central incisors are erupted and one deciduous lateral has been shed. In the second model, the left lateral incisor is erupting behind the central incisor and in close proximity to the left cuspid. In the third model, taken six months later, the left cuspid has been lost and the lateral incisor has moved into its space. There was no caries present, nor was the tooth knocked out. Figure 22 shows what is happening in a similar case. The lateral incisor, in attempting to move into a labial position, has caused a premature resorption of the cuspid root. This type of resorption pro-

TABLE II.

Average Age for Shedding the Deciduous Teeth.

Wealthy Children:	(*a.*) Boys.				(*b.*) Girls.			
Teeth.	Upper.		Lower.		Upper.		Lower.	
	A.[1]	s.[2]	A.	s.	A.	s.	A.	s.
Central incisor	7.10	±0.89	6.44	±0.97	6.80	±0.58	6.15	±0.92
Lateral incisor	8.16	±1.29	7.44	±1.26	7.60	±1.40	6.97	±0.92
Canine	11.47	±1.46	10.57	±1.41	10.72	±1.55	9.75	±1.33
Molar 1	10.67	±1.43	10.84	±1.69	10.32	±1.54	10.13	±1.55
Molar 2	11.47	±1.77	11.65	±1.99	11.06	±1.79	10.79	±2.00

Poor Children:	(*c.*) Boys.				(*d.*) Girls.			
Teeth.	Upper.		Lower.		Upper.		Lower.	
	A.	s.	A.	s.	A.	s.	A.	s.
Central incisor	7.13	±1.29	6.65	±0.94	7.21	±0.98	6.55	±0.91
Lateral incisor	8.45	±1.34	7.74	±1.27	8.30	±1.20	7.59	±0.89
Canine	11.31	±2.05	10.97	±1.80	10.78	±1.48	9.77	±1.26
Molar 1	9.41	±2.42	8.72	±2.95	9.15	±2.14	8.84	±1.92
Molar 2	10.13	±2.43	9.26	±3.04	10.01	±2.03	9.07	±2.57

[1] A = average age in years. [2] s = standard deviation in years.

Fig. 19.—Hellman's chart showing average age for shedding of deciduous teeth.

Fig. 20.—Type of malocclusion resulting from premature loss of one lower deciduous cuspid.

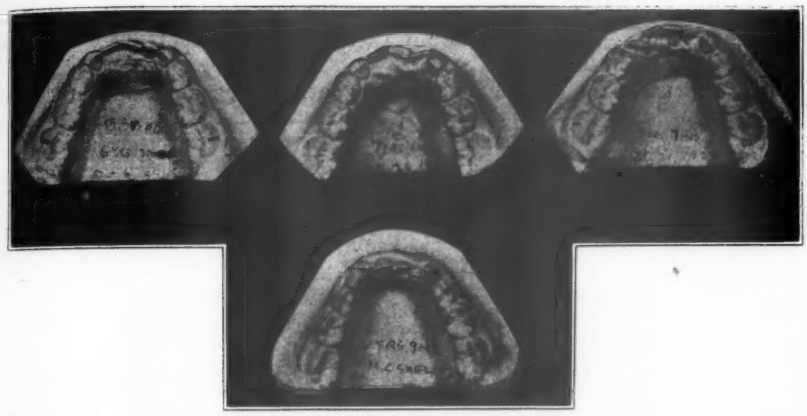

Fig. 21.—Type of eruption which often causes premature loss of one deciduous cuspid. Above: Condition of case over period of one year, showing loss of one cuspid. Below: Another case in which process of resorption is going on.

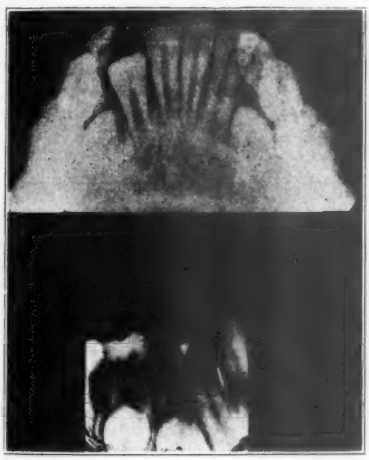

Fig. 22.—Premature resorption of cuspid root as result of abnormal eruption of lateral incisor.

ceeds until the cuspid is shed. Now here is an important and interesting point. It should be noted that, in these cases, the usual intercuspid dimensional growth does not as a rule occur during eruption. (Fig. 23.)

The question is, what may we do in these cases? First of all, there is the importance of getting these patients in at an earlier age for examination and observation, through the mediums of both successive models and roentgenograms. Secondly, when such phenomena occur, we may institute preventive measures. We may produce intercuspid increase artificially to allow incisor adjustment. It may be argued that, in so doing, we may cause a more rapid resorption of the cuspid root, but, even so, we are at least preserving the cuspid space, a thing Nature does not do as a rule. Figure 24 shows what was done in the case presented in the lower part of Figure 21. Figure 25 shows the roentgenograms taken after the correction. Six months was required for the treatment of this case. While some resorption took place, the condition appears more nearly normal and the position of the cuspids seems to be quite normal. In any case, here is a modifying condition that can be influenced by orthodontic procedure, usually to the benefit of the patient.

This item points to the need for further study of the etiology of premature loss of the deciduous teeth, a subject much neglected in our research. Such a study is now in progress at the Merrill-Palmer School in Detroit and will be presented sometime during the coming year. I should like to thank the many members of the dental profession who have sent me excellent material which was gathered in their individual practices. Without this material, the study could not be made.

During the years that I have been investigating growth problems as related to arch growth and occlusion, the question that has arisen constantly is this: How are we as orthodontists to pass judgment on the case presented by the individual child? On the basis of the material that I have presented, it would seem that, except when modifying conditions that are within our control arise, developmental diagnosis offers the best solution. In such a diagnosis, each examination serves as a check on the preceding one, and the orthodontist has an excellent basis for appraising growth. Such a method often shows the rate of progress of growth and development, which is often more important than the level at which the child happens to stand at the moment.

308 Whitney Building.

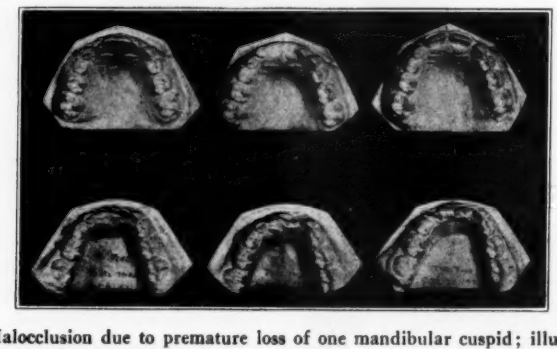

Fig. 23.—Malocclusion due to premature loss of one mandibular cuspid; illustrating lack of intercuspid increase during eruption of permanent incisors.

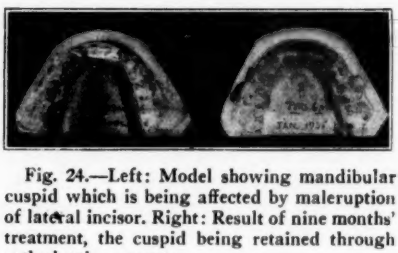

Fig. 24.—Left: Model showing mandibular cuspid which is being affected by maleruption of lateral incisor. Right: Result of nine months' treatment, the cuspid being retained through orthodontic measures.

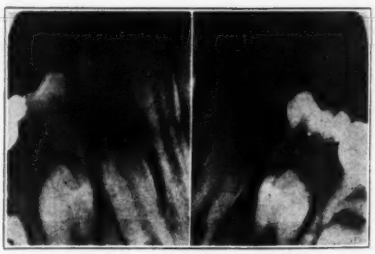

Fig. 25.—Case shown in Figure 24, at end of treatment. The appearance of the resorption areas is normal, the permanent cuspids following the path of resorption. The roentgenogram shown in Figure 22 was taken before treatment was started.

A REPLY TO BECKS AND SIMMONDS' CRITICISM*

By MARTHA R. JONES, Ph.D.; NILS P. LARSEN, M.D., and GEORGE P. PRITCHARD, D.D.S., Honolulu, Hawaii

IN a paper that was published in the October, 1935, issue of THE JOURNAL, under the caption "Dental Caries and Paradental Disturbances: I. Importance of an Adequate Diet for Health of Teeth and Paradentium," Becks and Simmonds describe nutritional studies which they are conducting on patients at the University of California College of Dentistry. Details of procedures, questionnaires on dietary habits, methods of evaluating a patient's diet and Becks-Simmonds dietary standards for the various nutrients (protein, fat, carbohydrate, calcium, phosphorus and iron) are given. According to the authors, "Diets 1 and 2 contain adequate amounts of all the minerals and vitamins as well as other dietary essentials." It appears to be very simple, and after reading through pages of menus, case histories and food tables, it is most disappointing to find in the last chapter the statement "It should be emphasized that as yet it is unknown whether these are 'caries preventive diets.' If nutrition is of importance for the health of the teeth and paradentium, the diets outlined may be considered adequate. It is hoped that they will prevent caries, as well as other dental diseases, where only a nutritional factor is at fault." The authors add that the diets contain "generous amounts of all factors, and if they are faithfully followed and good oral hygiene is practiced, the incidence of caries and disorders of the paradental tissue in individuals free from metabolic disturbances should be markedly reduced."

In another section, the authors state: "It cannot be stressed too often that all persons working in the field of diet and its relation to dental problems should exercise extreme care in drawing far reaching conclusions." The wisdom of such advice cannot be questioned. Being fully conscious of it, as they are, one wonders how Becks and Simmonds reached their own conclusions concerning dietary prescriptions for dental disease, and why they advocate them without a single case supporting their asserted adequacy in *"all* the minerals and vitamins and other dietary essentials." Becks and Simmonds cite the work of Jones, Larsen and Pritchard[1] as an example of those who have drawn "far reaching conclusions," and state that "a study of their work has recently been undertaken by A. J. Ker of the University of California College of Dentistry, and a summary of a critical review will appear in THE JOURNAL."

The California group does not seem to question that a diet consisting essentially of fish, taro, sweet potatoes, fruits and vegetables is compatible with sound teeth or that a fish, fruit, vegetable and grain diet is associated with rampant tooth decay. They seek for an explanation in the increased amount of calcium obtained from the substitution of taro and sweet potato for rice, although they admit that the so-called "rather gener-

*From the Research Department of the Queen's Hospital.

1. Jones, Martha R.; Larsen, N. P., and Pritchard, G. P.: D. Cosmos, 72:439 (May), 575 (June), 685 (July), 797 (Aug.) 1930; Am. J. Dis. Child., 45:789 (April) 1933; J.A.M.A., 99:1849 (Nov. 26) 1932.

ous" increase is comparative rather than absolute. They state: "The question of the assimilation or the retention of the available calcium, as the problem applies to babies and their dental conditions in Hawaii, is one which Jones and her co-workers have not given sufficient attention." Since cow's milk is a newly introduced food in the islands and bears no demonstrable relationship to the incidence of dental disease, we regard it as an excellent, though not indispensable, food. Taro, also, is by no means an indispensable food in Hawaii. Whatever its virtues may be in regard to preservation of the teeth, they are shared by fruits, potato and other vegetables.

As to assimilability of calcium in milk and vegetables, Sherman reported in connection with metabolism studies on children ". . . better storage resulted when the calcium was furnished in the form of milk than when even one half of the milk was replaced by vegetables of equal calcium content." Furthermore, if stature and physical development are a measure of assimilation of calcium and phosphorus, it is difficult to explain why so many large and physically well developed children in Hawaii have teeth ravaged by decay. To know whether the calcium in poi is more readily available than is the calcium in milk might prove of value. Relatively speaking, it seems unimportant among the innumerable aspects of the problem yet to be investigated. We shall leave to Becks and Simmonds the study outlined by them.

Becks and Simmonds state further:

In addition, it may be said that if the solution of the problem of tooth disintegration in Hawaii is merely one of changing the diet from acid to alkaline as stated by Jones and her co-workers, and the minerals and vitamins have little to do with the prevention of the condition, it is not clear why sodium bicarbonate was not added in the place of poi, fruits, vegetables and milk. Is the dental profession to understand that these workers believe the beneficial effects they secured by the use of milk, fruit, poi and vegetables with an abundance of sunshine to be due solely to physical changes indicated by the shift of the urine from a markedly acid to a less acid reaction? . . . In the light of their statements that calcium and phosphorus and vitamins have little to do with the condition, we are at a loss to understand their point of view. The experiments recently published have not convinced us of the importance of a low alkali reserve in the production of bone disturbances. Until the Hawaiian group presents data showing that tooth decay (also odontoclasia) can be arrested or prevented only by the addition of sodium bicarbonate (to substaniate their theory that a high alkali reserve is essential in the tropics) we are unable to accept their work.

Referring to the papers of the Hawaiian group cited, various factors which may play a part in tooth decay were discussed under the headings of "Race," "Heritage," "Prenatal," "Age," "Function," "Bone Growth," "Oral Hygiene," "Diet" and "Inter-Relations of Certain Factors." Under "Diet," "Minerals" and "Vitamins" were considered separately. The introductory statement under "Vitamins" is as follows:

Fruits and vegetables are rich sources of vitamin A, vitamin B and vitamin C and poor sources of vitamin D, the antirachitic factor. It would seem offhand that vitamins might be the determining factor. However, when supplied in the form of cod-liver oil, which is the richest known source of "A" and "D" (irradiated foods excepted), of eggs or of milk, both human milk and fresh unpasteurized cow's milk, orange and tomato juice, these vitamins, in good measure, fail utterly to prevent the rampant disintegration of the teeth of the babies born in Hawaii.

Under the heading "Minerals," the following statement appears:

Fruits and vegetables are also rich

sources of the bone and tooth forming constituents, but the latter are not so easily assimilated by man as they are in the form of milk. They are also rich in sodium and potassium, particularly the latter and when burned in the body leave an alkaline ash. It is interesting and probably significant that in Hawaii the diets that contain a preponderance of basic elements either in the form of greens and fruits or taro and sweet potato are associated with sound enamel. Evidence available does not indicate whether this is due to the excess of base, as such, or to some factor or combination of factors of which we have no knowledge. The absolute amounts of minerals in the diet, within certain limits, does not appear to bear any relation to the incidence of dental decay.

In two subsequent papers,[2] the following statements are made:

There appears to be a relationship between alkali requirement and age, vitamin D, climate and disease, assuming that the diet is otherwise well constituted . . . it may be that there is some unknown factor in fruits and vegetables which is specific for dental caries and that the leafy vegetables are particularly potent in this respect. However, until that factor is discovered, the potential alkalinity of an otherwise adequate diet seems to furnish a dependable guide for the control of dental disease.

Another statement to the effect that we in Hawaii have advanced a theory that "a high alkali reserve is essential in the tropics" is, as are those cited, unsubstantiated by fact. We did state in one of the papers referred to by Becks and Simmonds:

. . . any influence which tends to increase the alkalinity of blood and tissue fluids above a certain optimal value, accelerates atrophy of the long bones and other hard tissues—alveolar process, cementum and dentin—which have their origin in the same embryonic tissue, and decreases the liability of enamel to decay. Vice versa, those influences which make the blood and tissue fluids less alkaline, within certain limits, promote calcification of bones, cementum and dentin and increase the liability of enamel to decay.

Did Becks and Simmonds read the papers referred to, or do their preconceived ideas cause them to so distort the facts?

Becks and Simmonds desire to see the children in Hawaii fed sodium bicarbonate, and they state that they cannot "accept" our "work" until we have presented data showing that tooth decay can be arrested by the addition of soda to the diet. Dr. Becks interpreted and reported the lesions in the bones and teeth of the dogs fed by the California Stomatological Research Group. Agnes Fay Morgan, who conducted the feeding experiments, reported that 100 per cent of the dogs fed on both normal and inadequate diets plus sodium bicarbonate, with and without vitamin D, developed "paradentosis" in varying degrees of severity. Kidney damage was found in those examined.

These experiments confirm those conducted by one of us (M.R.J.) while associated with the California Stomatological Research Group. The effect on bone and "paradentium" (Becks) of long continued feeding of alkali is undoubtedly well appreciated by Becks and Simmonds. Another aspect of this type of dietary imbalance is a general metabolic upset resulting probably from the neutralization by the alkali of the free hydrochloric acid in the gastric secretion. A certain degree of acidity in the stomach contents is essential for normal digestion. The long continued use of soda that is necessary to produce obvious bone and dental lesions would not only neutralize acid formed, but also might completely in-

2. Jones, Martha R.; Larsen, N. P., and Pritchard, G. P.: D. Cosmos, 76:395 (April) 1934. Jones, Martha R.: D. Cosmos, 77:535 (June), 651 (July), 747 (Aug.) 1935.

hibit the secretion of hydrochloric acid in the stomach and start a succession of ills which would persist through life. To destroy lower animals in the interest of science is one thing, but to wreck the lives of helpless children entrusted to one's care is quite another. If such an experiment is required to convince Becks and Simmonds of the validity of our work, it is quite safe to say that we shall never enjoy their support. May we suggest that they repeat our observations on cases of their own selection?

Becks and Simmonds describe certain diets in the dog experiments conducted by Dr. Morgan that resulted in bone abnormalities as follows: "The diet responsible for these severe changes contained a salt mixture which was low in calcium and relatively high in phosphorus (owing to the low calcium content of the mixture) and contained no cod-liver oil." The title of the paper in which these experiments were described by Dr. Morgan was "The Effect of Acid, Neutral and Basic Diets on the Calcium and Phosphorus Metabolism of Dogs."[3] Of the four diets reported that were low in calcium and contained no vitamin D, one was highly acid and three were highly alkaline in potential reaction. Dr. Morgan reports that "typical clinical parodentosis was seen in the low calcium group without vitamin D and in all the alkaline fed dogs on normal diet as well." The dogs fed on the highly acid diet without vitamin D suffered the most severe lesions and those on the "neutral" diet were the most nearly normal. Imbalances on either the acid or the alkaline side had a profound effect.

It should be stated that Dr. Morgan's so-called "neutral" diet contained an excess of from 4 to 8 c.c. normal alkali per kilogram of body weight. Such an excess of alkali in human diets would be extremely high. The term "neutral" as used is misleading. Why do Becks and Simmonds fail to mention these facts, which they could hardly have failed to recognize and appreciate? Have they, as have certain others, developed an obsession on the possible significance of the acid-base balance of the diet? Do they analyze their diets from the standpoint of acid-base balance, and are they in a position to say with surety that this factor is in no way concerned with mineral balance in the body? We believe not, from the fact that, in a footnote appended to their tables, it is stated "Gravy, salads, desserts and 'extra foods' are not included." Among the vegetables that they regard as interchangeable are "corn, peas, carrots, greens, cauliflower, string beans, turnips and onions." A serving of corn (about one-half cup) yields approximately 2.7 c.c. excess acid and an equal amount of spinach yields 27.0 c.c. of alkali.

In experiments on man in which rice was substituted for potato in a mixed diet, Sherman and Gettler[4] found that the fixed acid production was increased. About 73 per cent of the increase could be accounted for by increased ammonia and titratable acidity of the urine. The remaining 27 per cent, according to the investigators, "may have been eliminated in part at least, through the skin or in the feces, or may have been neutralized by the buffers of the blood with a corresponding increase in carbon dioxide output, and a decrease in the alkalinity of the body." Blatherwick[5] likewise found that foods with a predominance of acid-forming elements tend to deplete the al-

3. Morgan, Agnes F.: Univ. Calif. Pub. Physiol., 8:61, 1934.

4. Sherman, H. C., and Gettler: J. Biol. Chem., 11:323, 1912.

5. Blatherwick, N. R., and Long, M. L.: J. Biol. Chem., 53:103 (July) 1922.

kali reserve of the blood. Is there any evidence to controvert these findings? Are we justified in dismissing their possible significance when we are confronted with a world problem that is so strikingly associated with the substitution of grains for roots and tubers? Do Becks and Simmonds have any authority for the standards they have set up, and on what bases are "corn, peas, carrots, greens, cauliflower, string beans, turnips and onions" interchangeable?

Becks and Simmonds mention the reports of a number of investigators who had observed arrested decay on improved dietaries, but did not discuss them. Some of those also reported high incidences of decay on diets containing calcium, phosphorus, iron and vitamins in excess of the amounts prescribed by Becks and Simmonds. Our analyses of some of the reports from the standpoint of acid-base balance and also of the Becks-Simmonds "adequate" diet, show that the latter is among the very low in alkali excess. According to our scale (3) the incidence of dental caries on Becks-Simmonds Diet 1 would have been close to 85 per cent. At the time Becks and Simmonds wrote their paper, they had completed "nearly 200 dietary studies." The time covered was not stated. Most investigators can determine whether decay is arrested or active in a few months. Some report changes in a few weeks or even days. Becks and Simmonds had nothing to report, but apparently were still "hoping" that the diet would prove effective. Having finished the paper, the reader is not quite certain whether the diet is or is not important for "health of teeth and paradentium." We wonder what the object of the paper might have been.

CERTIFIED ZINC PHOSPHATE CEMENTS*

SAMPLES of all zinc phosphate cements certified to the Research Commission of the American Dental Association by the various manufacturers were procured in the open market by the Research Commission and tested by the A.D.A. Research Associates at the National Bureau of Standards. As of Jan. 1, 1936, the following list of cements were found to comply with American Dental Association Specification No. 8. Cements which did not comply are omitted from this list.

The powders and liquids of the cements listed below were found to conform to the requirements prescribed by the U. S. Pharmacopeia (current edition) regarding arsenic content.

SECOND SURVEY OF ZINC PHOSPHATE CEMENTS

Cement	Manufacturer or Distributor
Ames, Z-M	The W. V-B Ames Co.
Caulk, Crown and Bridge	The L. D. Caulk Co.
Caulk, Tenacin	The L. D. Caulk Co.
Smith, Certified	Lee S. Smith & Son Mfg. Co.
S. S. White, Zinc	The S. S. White Dental Mfg. Co.

*A.D.A. Specification No. 8, J.A.D.A., 21: 1921 (Nov.) 1934.

*From the Research Commission of the American Dental Association (released Jan. 1, 1936, by the Executive Board, C. T. Messner, Secretary).

The Journal of the American Dental Association

212 East Superior St., Chicago, Ill.

C. N. JOHNSON, Editor

Published by the American Dental Association

All expressions of opinions and all statements of supposed facts are published on the authority of the writer over whose signature they appear, and are not to be regarded as expressing the views of the American Dental Association, unless such statements or opinions have been adopted by the Association.

Communications intended for publication in the scientific or literary pages of THE JOURNAL should be addressed to the Editor. All advertising or business matter should be sent to the Business Manager.

Subscription is included in the annual membership dues. The subscription rate to non-members is $5.00 a year in advance, this rate applying to both domestic and foreign subscribers. All foreign subscriptions are to be paid in United States money.

Editorials

IDENTIFICATION OF THE DEAD FROM DENTAL RECORDS

In the present issue, we publish a paper by Alfred P. Rogers of Boston, Mass., that was read before the Section on Orthodontia at the New Orleans meeting in November. We commend this paper to the careful reading of our members as an example of great exactness in the interpretation of records.

The case referred to is one that has been published extensively in our dental literature, and it would be a real achievement if by this means a clue were given that would eventually establish the identification of the victims, and the perpetrator of the crime.

Dr. Rogers and his associates are entitled to great credit for the detailed presentation of all available evidence, and we ask every reader and in particular every orthodontist to carefully study the recorded data in this case and check it with their own cases. Surely, among the orthodontists, particularly those doing the class of work represented by the appliance illustrated, there must be found some man who, if he deliberated with sufficient care, could throw some light on the case. The least bit of evi-

dence, even of an indirect nature, might possibly lead to a clue, eventually starting a train of investigation that would aid the authorities in running down this case.

In a certain sense, the dental profession is on trial, and we should leave no stone unturned to justify the reputation that we have been making in the past to the effect that dental service may be used as a medium of identifying the dead when all other evidence has been obliterated. As has repeatedly been said, the teeth last longer than any other structure in the human body. They resist decomposition and disintegration longer than any other tissue, and have frequently been made the means of identification through the evidence presented in the dental work done on the teeth during the lifetime of the individual. Some day, some one should catalog the cases on record wherein dentistry has contributed to this kind of identification, to the end that a record be made for the benefit of the civic authorities.

And, in this connection, every person practicing dentistry is under the deepest obligation to make accurate records of his work and preserve them carefully for any future reference that may conceivably be called for. The authorities are becoming constantly more and more alert to the value and significance of dental evidence of this character, and ordinarily if a decomposed body is found anywhere, they naturally appeal to the dentist for any available evidence. This is becoming so much a matter of habit with the authorities that every dentist should safeguard his reputation by preserving his records. What would be the reputation of the dentist or what would be his status in the community if anything happened to a former patient of his and the authorities should appeal to the dentist for aid in identification and he was obliged to admit that he did not keep records? No one in the community would have any respect for such a man, and the authorities in particular would immediately put him down as a professional man unworthy of confidence.

Dentists owe something to the community in more ways than one, and this happens to be a particular obligation that cannot be ignored. There are so many ways in which records may be valuable that it is inconceivable that any practitioner should ever

be careless in this regard. It matters little what particular method is used in making records as long as they are accurate and intelligible, but to refuse to keep records at all may some day prove fatal to the reputation of the practitioner who is thus negligent.

The case presented by Dr. Rogers constitutes a notable and in many respects a mysterious crime wherein three human lives were ruthlessly sacrificed, leaving so far no clue to the perpetrators. Apparently, the only possible evidence on which to base a clue is found in the dental work that had been done on the victims. The length of time during which the bodies had lain almost exposed had obliterated all evidence except the dental evidence. As we have said, the tissues of the teeth persist longer than any of the other tissues. Not only that, but the materials that dentists use in the repair of the natural teeth, whether of gold or amalgam or porcelain, must withstand influences tending to decomposition and disintegration to an unusual degree. Of necessity, they must be of a stable character to maintain their integrity in the presence of conditions in the mouth, where they encounter extremes of heat and cold, and of violent chemical reactions, to say nothing of the influence of attrition and stress.

And, incidentally, it is a fortunate circumstance that the practice of dentistry has always demanded for its service materials of great purity and reliability. This very fact has contributed in no small measure to the high order of technical skill that has been manifest in the profession ever since dentistry had a name, and now we have one more avenue of service in the possible aid to the citizens of the state through providing the means whereby identification may be established and the guilty may be punished. Every tangible tie-up of this kind between the state and the profession will tend to magnify dentistry in the public mind and furnish it a legitimate and generous meed of recognition.

ONE PHASE OF DENTAL TEACHING

More and more, the methods of training students in dental schools are coming in for observation. An honest effort is being made all along the line on the part of teachers to improve the

quality of dental instruction, and sometimes we are led to wonder, on the basis of our state board examinations, why the finished product is not better than it is. Surely, there is no laxity of application to the allotted task on the part of the instructors in our dental schools, and surely the curriculum has been extended with sufficient rapidity to fully answer the demands of progress.

Matriculation requirements have been steadily raised, with the announced conviction that the human material for making dentists would show a resultant superiority over previous periods. The promise was implied if not definitely stated that the young men and women coming to our dental schools from a higher matriculation preparation would consequently be so endowed mentally that not only would their dental training be greatly facilitated but also the finished product would be vastly superior.

There is no way of estimating the soundness or fallacy of this prediction. An analyst would exhibit some hardihood to state dogmatically whether the graduates of today are better or worse than those trained before the higher matriculation requirements were in vogue. It would be reasonable, of course, to assume that they are better, that students are more proficient and more perfectly prepared for their destined career than the students of other days. If they are not, the whole fabric of our dental educational system must be open to question. It would be strange indeed if, with all of the study that has been put into this enterprise of dental education, graduates were not more proficient than formerly. Yet we sometimes wonder whether the improvement is commensurate with the implied promise at the time that the requirements were raised.

We cannot escape the conviction that somewhere along the line there has been a breakdown in our expectations of improvement, but we are not willing to admit that there has been any lack of application to the task on the part of our college teachers or college authorities. We have sometimes been led to wonder whether the quality of our matriculates has advanced in conformity with our advanced standards. Here again, we do not know, nor is there any certain way of finding out. Be it known that this problem of dental education is a complicated one, and before we have

it in any way solved, we are destined to devote much additional time and study to it.

But, if we cared to be specific, there are at least two considerations in which we feel that definite improvement might be made in our approach to the problem of training dental students in college. Both have reference to the contact between instructor and student. One is a technical problem and the other an ethical one, and both are exceedingly important.

The technical problem relates to the manner of coaching students in their practical work, and it is almost wholly a demonstrator's problem. In the early years of the practical course, the technics of the subject must necessarily be taught on models. This for two reasons: first, because of the demand for a certain amount of manual training without which no student is properly equipped, and, secondly, in order to impart a reasonable knowledge of the fundamental principles involved in all of our technical procedures. We think it safe to assume that, for the most part, technical procedures are reasonably well taught, and it is only when the student begins to work on patients that the real test of training begins. It is here that we believe a radical departure should be made in our teaching methods.

First, let us revert to the usual procedure when a student is assigned a patient in the chair. What seems more natural than for the student to appeal to the demonstrator for instruction as to what shall be done? The student naturally expects to be told what to do, and the demonstrator is supposed to be there for the purpose of telling him. It all seems so logical and so natural, but this routine may easily be carried so far as to be fatal to the initiative and development of the student's mind. The real object of teaching is not to try to cram a certain amount of knowledge into a student's head, but to bring out the reasoning faculties of the student and compel him to do some thinking for himself. After the barest fundamentals are taught, the demonstrator should more and more demand that the student cultivate the power of judging for himself what should be done under given circumstances. When a student propounds the usual question, "Doctor, what shall I do with this case?" the demonstrator, instead of telling him what to do, should say: "What would *you* do in this

case?" And he should insist that the student study the case and formulate an opinion of his own. The opinion may not be sound, but at least the student has been compelled to think, and it is easy for the demonstrator to correct an erroneous opinion before any harm is done to the patient. If every student were compelled to reason out a case in each instance, it would tend to develop his thinking capacity and prepare him for actual practice when he graduates. This idea of training a student to think should be carried out rigidly, one of the advantages being that the student is taught diagnosis in connection with his practical training. The radical adherence to this routine would result in better training of students and better service to patients.

The other consideration to which reference has just been made is a matter the importance of which cannot be overestimated, and it is something that has seldom been sufficiently stressed even in our better schools. One thing above all others should be impressed on every dental student, in season and out of season, and that is the fundamental obligation to be a gentleman under all circumstances. This should not merely be accepted as a theory, but it should be part and parcel of a student's daily training and daily life. It is important of course that a student be instructed in the science and art of his craft, but, above and beyond all this, he should be taught, as nearly as it is possible to teach a student, the instincts and demeanor of a gentleman. Professional life entails on the individual a greater obligation in cultural exactions than is involved in even the best principles of commercial life, and students should have this conviction ingrained in them at every turn of their college career.

If dentistry is ever to measure up to the full stature of a cultured and learned calling, it can do so only by beginning at the fountainhead and molding the immature and sometimes the more or less incongruous mind of the student body. It is, therefore, in a very intimate way, the obligation of the teachers in our colleges to exert their utmost endeavor toward training men who shall not only be skilled in technical and scientific acumen, but also possess a cultural background worthy of the best traditions and the most exalted conception of what true professional life should represent.

PRACTICE IN PARAGRAPHS

This department is intended for busy readers. It aims to tell a vivid story in a few words. Items should be of a practical character, and free from padding—not more than a paragraph or two. We exact no limit, but two hundred words can tell most of these stories. Send in your ideas; they will be welcome.

Hobby—Have a pleasure hobby. You will live longer.—*C. C. Norris, Oshkosh, Wis.*

Promises—Do not promise more than you can do, but do more than you promise.—*C. C. Norris, Oshkosh, Wis.*

Glare—Too much light from the window of the operating room is very hard on the patient's eyes.—*C. C. Norris, Oshkosh, Wis.*

Avoiding Disease—Why expose your patients, family and self to disease when it takes you but two minutes to change your entire uniform? Dress in white.—*C. C. Norris, Oshkosh, Wis.*

Patience—It is a good practice to cultivate patience and tolerance and listen to the patient's complaints most attentively. One should make this a rule and strictly adhere to it.—*James L. Zemsky, 147 Fourth Ave., New York City.*

Nonpathologic Areas of Bone Rarefaction—Radiolucent areas surrounding the crowns of unerupted and malposed teeth are often due to the presence of tooth follicles and should not be interpreted as indications of the presence of infection.—*James L. Zemsky, 147 Fourth Ave., New York City.*

Best Dressing for Wounds—A blood clot is the best dressing material; therefore, a wound which bleeds freely, and in which the blood clots well, should not be packed or dressed with iodoform gauze or any other dressing material, for this will only interfere with normal healing.—*James L. Zemsky, 147 Fourth Ave., New York City.*

Looking Vs. Staring—Some patients are greatly annoyed by the staring dental assistant. Looking and staring are entirely different visual efforts. The head waiter of a hotel looks at and sees everything, but stares at nothing. Some assistants with a concentrated riveted stare spend entirely too much time directly in front of the chair. —*Herbert Ely Williams, Red Bank, N. J.*

Semiluxury—Dentistry is a semiluxury which one can somehow get along without. If patients feel that they cannot afford something in which their health is vitally concerned, but still can finance many other beauty adjuncts, we might suggest to them that they try to get along without dentistry entirely as their greatgrandfathers did.—*Herbert Ely Williams, Red Bank, N. J.*

Rest After Extraction—Patients who have had an extraction performed, unless the operation has been a very simple one, should be directed to go home and rest. Going from the chair to a bridge party, a round of shopping or any other form of exertion is obviously unwise, the consequent fatigue resulting in more than necessary postoperative discomfort and slower recovery.—*Edward C. Duryee, Peekskill, N. Y.*

Word Saving—Many short distance telegraphic messages cost 25 cents for ten words and 2 cents for each additional word. Long distance (marathon) writers should be taxed on that basis. They then might be less liable to quote what many other writers had said many years ago about many different subjects. Then more articles would be read by many more readers—from beginning to end.—*Herbert Ely Williams, Red Bank, N. J.*

Imitating Black Marble for Your Cabinet—Dentists who have desired a black marble top for their cabinets, but have hesitated to install one because of the cost, can make an imitation that is hard to detect. First, have a piece of plate glass cut and the edges rounded. Then have one side of this sprayed with black enamel paint. Finally, cover the top of the cabinet with a black paper to prevent scratching the paint and place your glass over this.—*Raymond M. Curtner, Ukiah, Calif.*

The Dentist Vs. Gold Foil—The only thing wrong with gold foil is the dentist himself who invariably says, "My patients don't want it," when in fact he has never told them how good it is. How often does a patient voluntarily request a denture de luxe, a full mouth roentgen-ray examination, an inlay or anything else other than a low fee product? When the wave of silicates and inlays deluged the profession, most dentists collected the rubber dam in one hand and their gold foil and pluggers in the other and forgot where they were put, and that is where they erred. It is human to err, but weak to keep on erring. No patient can be expected to know about gold foil and want it, unless he is told about it and gets it.—*Herbert Ely Williams, Red Bank, N. J.*

Removal of Deeply Broken Off Roots—To simplify the removal of deeply broken off roots, a buccal flap, sufficiently large to expose the area to be operated on should be used. This serves a twofold purpose: it affords (1) better light, and (2) a drier field, since most of the bleeding comes from the soft tissue. Many eminent oral surgeons mention the fact that blind surgery is poor surgery. If more men, practicing extraction, would realize this, they would be able to simplify their work. To attempt delivery of a root by the sense of touch is not in keeping with modern thought. There is the possibility of forcing the root into the antrum or into the mandibular canal, with resultant injury to the nerve, not to mention the waste of time, additional trauma and shock. When the field is dry, it is possible for the operator to determine whether it is necessary to cut a small portion of the buccal plate away or to enlarge the socket with small bone drills so that root testers can be used. After removal of the root, the tissues should be cleaned of débris and all rough edges of bone smoothed. Then the mucoperiosteal flap is sutured neatly into place. There is usually little postoperative pain with this method.—*Julius Caplan, 4802 Broadway, Chicago, Ill.*

COUNCIL ON DENTAL THERAPEUTICS

ACCEPTED DENTAL REMEDIES

The following articles have been accepted as conforming to the rules of the Council on Dental Therapeutics of the American Dental Association. The Council desires dentists to understand that the admission of an article does not imply a recommendation. A copy of the rules which govern the Council in the consideration of articles will be sent on request.

SAMUEL M. GORDON, *Secretary*

DYES*

The Triphenylmethane (Rosaniline) Dyes'

Crystal Violet-Calco.—A brand of crystal violet.
Manufactured by the Calco Chemical Company, Inc., Bound Brook, N. J.

Brilliant Green-Calco.—A brand of brilliant green.
Manufactured by the Calco Chemical Company, Inc., Bound Brook, N. J.

*A.D.R., 1935, p. 96.
1. A.D.R., 1935, p. 104.

Anesthetics—Local*

Reliance Procaine Solution with Epinephrine Bitartrate 1:20,000: Each cubic centimeter is said to contain: procaine hydrochloride, U.S.P., 0.02 gm.; epinephrine bitartrate, A.D.R., 0.09 mg.; sodium chloride, 0.0015 gm.; disodium phosphate, exsiccated (U.S.P.), 0.001 gm.; sodium bisulphite, 0.002 gm., and distilled water to yield an isotonic solution.
Manufactured by Reliance Dental Manufacturing Company, Chicago, Ill. No U. S. patents or trademarks.
Reliance Procaine Solution with Epinephrine Bitartrate, 1:20,000 in cartridges, 2 to 2.5 c.c.
Reliance Procaine Solution with Epinephrine Bitartrate, 1:20,000 in ampules, 2.5 c.c.
Reliance Procaine Solution with Epinephrine Bitartrate, 1:20,000 in bottles, 60 mils, 125 mils.

Reliance Procaine Solution with Epinephrine Bitartrate, 1:30,000: Each cubic centimeter is said to contain: procaine hydrochloride, U.S.P., 0.02 gm.; epinephrine bitartrate, A.D.R., 0.06 mg.; sodium chloride, 0.0015 gm.; disodium phosphate dihydrate, 0.001 gm.; sodium bisulphite, 0.002 gm., and distilled water to yield an isotonic solution.
Manufactured by Reliance Dental Manufacturing Company, Chicago, Ill. No U. S. patents or trademarks.
Reliance Procaine Solution with Epinephrine Bitartrate, 1:30,000 in cartridges, 2 to 2.5 c.c.
Reliance Procaine Solution with Epinephrine Bitartrate, 1:30,000 in ampules, 2.5 c.c.
Reliance Procaine Solution with Epinephrine Bitartrate, 1:30,000 in bottles, 60 mils, 125 mils.

Reliance Procaine Solution with Epinephrine Bitartrate, 1:50,000: Each cubic centimeter is said to contain: procaine hydrochloride, U.S.P., 0.02 gm.; epinephrine bitartrate, A.D.R., 0.036 mg.; sodium chloride, 0.0015 gm.; disodium phosphate dihydrate, 0.001 gm.; sodium bisulphite, 0.002 gm., and distilled water to yield an isotonic solution.
Manufactured by Reliance Dental Manufacturing Company, Chicago, Ill. No U. S. patents or trademarks.
Reliance Procaine Solution with Epinephrine Bitartrate, 1:50,000 in cartridges, 2 to 2.5 c.c.

Reliance Procaine Solution with Epinephrine Bitartrate, 1:50,000 in ampules, 2.5 c.c.
Reliance Procaine Solution with Epinephrine Bitartrate, 1:50,000 in bottles, 60 mils, 125 mils.
*A.D.R. 1935, p. 34.

THE PRACTICAL VALUE AND LIMITATIONS OF TOPICAL ANESTHESIA IN ORAL SURGERY

By M. L. TAINTER, M.D., and S. M. MOOSE, D.D.S., F.A.C.D., San Francisco, Calif.

The following article was prepared at the request of the Council as many inquiries have been received on topical anesthetics, both proprietary and nonproprietary The Council has authorized publication of the report as one in the series of articles on pharmacology and therapeutics.

Elsewhere in this issue (page 244) appears an article, "Studies in Topical Anesthetics, I Efficacy of Certain Common Anesthetics on the Gums," a report of experimental work done in the clinic of the College of Physicans and Surgeons, a School of Dentistry in San Francisco, by the same authors, and undertaken at the request of the Council. The more detailed results afforded in this article, with the general remarks published below, should enable the practitioner to evaluate most, if not all, of the claims made for the proprietary topical anesthetics on the market. Those preparations found to be of some usefulness are listed in the book Accepted Dental Remedies.

SAMUEL M. GORDON, *Secretary*

There is constant need in dental practice for methods of depressing sensation in the teeth and gums so that dental work can be done painlessly. In those cases wherein the pain of a procedure is very severe, an anesthetic is commonly injected which completely abolishes the pain. Such an injection is often difficult, requires special sterile solutions and skilled technic and may give rise to undesired reactions. For these reasons, injection anesthesia is not used except where it is indispensable. A considerable part of dental work causes discomfort insufficient to necessitate infiltration anesthesia, and yet often severe enough to make its alleviation desirable. For this purpose, an anesthetic or analgesic which could be applied topically, that is, to the surface without injection, would be of great practical value. Many drugs and combinations of drugs have been employed in the past and are still being advocated for this purpose. The aim of this article is to point out some of the fundamental facts which need to be considered in this connection and to discuss the practical limitations of such medication.

There are two distinct problems involved in oral topical anesthesia. One is to secure anesthesia of the soft structures such as the gums and exposed pulp, and the other to anesthetize the hard structures of the tooth. The dentin is especially difficult to anesthetize. Complete anesthesia probably requires penetration through to the pulp, and since this is probably possible only by diffusion through the tubules, it must necessarily be irregular, slow or incomplete. The dentin can readily be dried, so that either aqueous or oily materials will wet it and be useful as vehicles for the anesthetic agent. The exposed pulp offers little difficulty, since the usual solutions for infiltration can be applied either with or without pressure, this depending on the depth to which the anesthetic must penetrate.

The gums and mucous membrane offer special problems. They are covered with a stratified squamous epithelium many cells in depth, which is not a good surface for absorption, since the anesthetic must penetrate through these cells before it can come in contact with the nerve endings. The membranes are also constantly bathed with a thick

viscid saliva, and cannot be readily wet by liquids which are not miscible with water, unless special care is first taken to dry the surface. As a result, the anesthetic agent must be dissolved in water, alcohol, glycerin or one of the glycols, which will make thorough contact with the membrane. Because of the dilution from the saliva, satisfactory anesthesia can be obtained only by maintaining a dry surface for application of the solution and by retaining it in contact with the epithelial surface for a period of from three to five minutes. This in itself is attained with difficulty, in spite of damming the parts with sponges or cotton rolls. The relative difficulty is dependent on the degree of ptyalism present, since the salivary secretion rapidly saturates the dams and dilutes the anesthetic solution contained on the applicator. Even though the anesthetic agent is sufficiently absorbable to penetrate the epithelial cells easily, it may not be able to paralyze the nerve endings, since, as soon as it gets below the stratified layers, it comes in contact with the lymph and blood circulation, which may remove it as fast as it is absorbed. For this reason, the rate of penetration must be greater than the rate at which the circulation can remove the agent. This usually necessitates the use of high concentrations of the anesthetic in order to push the rate of penetration up to an effective level.

The agents which are used topically for the mucous membranes comprise almost the entire list of local anesthetics. They are not all of equal value, but each one has its group of advocates. Procaine is used in 20 per cent strength, cocaine, 1 to 5 per cent, butyn, 10 per cent, and tutocain, 5 to 10 per cent. In a special group are benzyl alcohol, which has a limited solubility in water (4 per cent) and hence is usually dissolved with alcohol, and saligenin, which is related to the salicylates. These two have an almost entirely negligible systemic toxicity and hence can be used in very high concentrations. Ethylaminobenzoate (benzocaine) is also relatively insoluble in water, but can be used in 10 per cent concentration in ointments or alcohol. A special use for benzocaine is in the form of troches or lozenges containing 15 mg. (one-fourth grain) of the compound. When one of the troches is allowed to dissolve in the mouth, enough analgesia of the mucous membrane results to minimize or prevent the nausea and gagging which may accompany holding roentgen-ray films in the mouth or taking impressions for dentures. Phenol penetrates well, but anesthetic concentrations are liable to damage the epithelium. The others are also liable to cause some local irritation or necrosis, since the concentrations applied to the surface are necessarily much higher than those which exposed tissue can well tolerate.

In an entirely different category is ethyl chloride. This agent is more difficult to apply, but, by chilling the tissues, it causes an analgesia which is more certain and rapid than that of drugs which have first to be absorbed. Its value is limited by its transient action and by the possibility of damaging tissue if too intense or too prolonged cold is used.

A common source of error in evaluating the merits of topical anesthetics is the failure to give proper weight to the low degree of sensitivity of the gum tissues. These tissues are so poorly supplied with pain nerve endings that ordinarily they do not give rise to pain of any serious intensity. In fact, the sensitivity may be so low as to make it difficult to determine whether the gum is entirely anesthetized or not. In the great majority of cases, the mucous membrane can, without the knowledge of the patient, be penetrated in every part of the mouth, except the palatal mucoperiosteum and particularly the anterior palatine papilla. The tissue in this vicinity is usually so dense that the average topical anesthetic fails to penetrate the connective tissue beneath the epithelium and pain is experienced as soon as the needle passes beneath the surface. The tissues in the mouths of children are particularly amenable to topical anesthesia; but, again, one must not expect anesthesia deep in the connective tissues and too many cases have inadequate anesthesia of the palatal mucoperiosteum.

The sensory reactions of patients vary, as does the sensitivity of the tissue of the oral cavity. This is comparable to the various degrees of sensitivity of the dentin of the

teeth in different persons. There is no question that the nerve endings are closer to the surface, more sensitive or more numerous in one patient than in another. It is also true that the psychic reactions of certain persons to certain types of stimuli play an important rôle. Often, the important factor is not the degree of pain as much as it is the fear of the needle. Delay of injection caused by the necessity for awaiting the absorption of a topical anesthetic may sometimes cause a greater psychologic reaction than immediate injection into unanesthetized tissues.

The technic necessary for any degree of success must be considered, since it enters into the practicability of the use of the available anesthetic solutions. Actual pain attending careful infiltration of an anesthetic can be minimized, or entirely eliminated, if the technic is delicate and the needle is sufficiently small and the razor sharp. Again, from the practical standpoint, the average operator, rather than wait the five minutes necessary for the anesthetic to act, especially in cases of multiple injections, prefers to use digital pressure on the spot to be injected, and sharp small needles. Another pressure method employs a 14 or 16 gage hard steel wire with a small loop on one end, bent to an angle of 90 degrees with the long axis of the wire handle. This is placed over the point of injection and held with pressure while the needle is inserted through the loop into the tissue. By this means, almost complete analgesia can be quickly secured.

CONCLUSION

It can be said that the topical anesthetics in current use do not penetrate deeply enough to ensure adequate anesthesia in a sufficient number of cases to be considered satisfactory. They are of some value in hypersensitive patients. The agent or solution has not yet been introduced that will produce adequate anesthesia at sufficient tissue depth with reasonable rapidity and without tissue irritation and toxicity. These properties are the prerequisites of an ideal topical anesthetic, but such an agent remains to be discovered.

BUREAU OF PUBLIC RELATIONS

A STATISTICAL STUDY OF CARIES IN THE DECIDUOUS AND PERMANENT TEETH OF CHILDREN*

By JOSEPH T. COHEN,† D.D.S., Minneapolis, Minn.

THE most perplexing dental problem of this age is, no doubt, the cause and elimination of caries. Considerable thought and study have been given to this problem by the dental profession, but to date the question has not been satisfactorily settled. It was thought that possibly a statistical study of the mouth conditions of a large group of school children might give some information regarding the type of child that is most susceptible to caries, the teeth most likely to be affected and the age at which these defects most frequently occur.

On examining 304 children under 3 years of age, Pitts[1] found dental caries in 26 per cent of all cases. In a study based on 1,202 children 6 years of age, Techow[2] concluded that, of all the deciduous teeth, the upper second molar was most susceptible to caries. Munblatt[3] examined 455 children from 2 to 12 years of age and found 30 per cent free from dental caries. Several thousand German children were examined by Kloeser,[4] who found that the deciduous teeth of the female were better than those of the male, while the reverse was true of permanent teeth. Of those examined, 94.12 per cent had dental caries.

In an examination of 154 public school children, from 7 to 12 years of age, Kierner[5] found caries in from 9 to 15 per cent of all the teeth. Many decayed teeth were found by Parker[6] in the mouths of children who came to the dental hospital for treatment. That children living in a good environment had better teeth than those living under adverse conditions was the conclusion reached by Broughton-Head[7] in a study of 2,010 school children in Glasgow, Scotland. Mouth conditions of 1,008 Zulus (negroes) were compared by Suk[8] with the conditions which existed in the mouths of many white children.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research), at the Seventy-Sixth Annual Session of the American Dental Association, St. Paul, Minn., Aug. 7, 1934.

†Dental Research Worker at the Institute of Child Welfare, University of Minnesota.

1. Pitts, A. T.: Some Observations on Occurrence of Caries in Very Young Children, Monat. f. Zahnheilk., March, 1916: abstr. Brit. D. J., 48:197 (Feb. 15) 1927.

2. Techow, G.: Distribution of Caries in Deciduous Teeth., D. Cosmos, 57:828 (July) 1916.

3. Munblatt, M. A.: Critical Study of Incidence of Dental Caries in Children, D. Cosmos, 75:592-609 (June) 1933.

4. Kloeser, R.: Statistics on Dental Caries, Deutsche Monat. f. Zahnheilk., August-November, 1913; abstr. D. Cosmos, 56:243-244 (Feb.) 1914.

5. Kierner, R. E.: Average Per Cent of Decay of Teeth from Six to Twelve Years of Age, abstr. West. D. J., 6:176, 1892.

6. Parker, Adams: Reliability of Different Classes of Teeth to Decay, Brit. J. D. Sc., 17: 235, 1874.

7. Broughton-Head, L. C.: Influence of Sex and Environment in Relation to Dental Caries and Dentition, Brit. D. J., 27:913, 1906.

8. Suk, V.: Eruption and Decay of Permanent Teeth in White and Negroes with Comparative Remarks on Other Races, Am. J. Phys. Anthropol., October-December, 1919; abstr. D. Cosmos, 65:1012 (Sept.) 1923.

He found caries in 85 per cent of the teeth of the white children, as compared to 15 per cent of those of the negroes.

Brekhus,[9] in a study based on 10,500 adult mouth examinations, found only 5 per cent of the lower first permanent molars unaffected by caries, at 20 years of age. In an examination of 7,942 men ranging from 17 to 24 years of age, Leigh[10] found the lower first molar defective in 90 per cent of all cases. Driak,[11] in 1,100 dental examinations, found caries less prevalent among men than among women. On examining 2,464 employes, Sappington[12] found that, although caries was quite evenly distributed among males and females, the teeth of the females gave evidence of better care. On examining 1,000 adults, Cramer[13] found more caries among the poorer class of people than among their richer neighbors. An examination of 1,197 Kansas City children under 6 years of age by Rypins[14] revealed that 4 per cent of all teeth were carious. Hyatt[15] concluded that the lower first permanent molar is the tooth most liable to be attacked by dental caries.

TABLE 1.—AGE DISTRIBUTION

Age	Male	Female	Combined
2	50	28	78
3	92	73	165
4	111	112	223
5	147	149	296
6	104	104	208
7	108	92	200
8	115	116	231
9	99	100	199
10	111	115	226
11	98	103	201
12	70	60	130
13	94	71	165
14	86	47	133
15	87	12	99
Total	1,372	1,182	2,554

The study here presented is based on the conditions found in the mouths of 2,554 children ranging in age from 2 to 15 years. The relative incidence of caries found in children coming from the higher socio-economic groups is compared with that in children coming from the lower socio-economic groups. Although it was desired to compare mouth conditions of children of the various races, only a Jewish group could be segregated with a reasonable degree of accuracy. A comparison of the teeth of Jewish and non-Jewish children was made. The mouth conditions of each age period and the conditions of each tooth for the various age periods was carefully charted.

This material was gathered from the following sources: Institute of Child Welfare of the University of Minnesota (199 cases); Minneapolis Public Schools (213 cases); University Hospital (506 cases); community clinics (1,040 cases); private practice (596 cases).

The children from private practice and the clinics were originally examined because of a dental defect or because the presence of dental trouble was suspected. The remaining children were examined

9. Brekhus, P. J.: Statistical Investigation on Loss of Human Teeth, J.A.D.A., 15:679-690 (April) 1928.

10. Leigh, R. W.: Incidence of Caries in Different Teeth and Surfaces, Oral Hyg., 14: 1202-1211 (July) 1924.

11. Driak, F.: Frequency of Caries in Population of Vienna, Ztschr. f. Stomatol., August, 1929; abstr. Brit. D. J., 50:1427 (Dec. 16) 1929.

12. Sappington, C. O.: Incidence of Dental Defects in 2,469 Employment Examinations, J.A.D.A., 1928, 14:2170-2174 (Nov.) 1928.

13. Cramer, H. C.: Dental Survey of One Thousand Adult Males, J.A.D.A., 16:122-128 (Jan.) 1929.

14. Rypins, R. F.: Incidence of Dental Caries in School Children, J. D. Res., 4:369 (Sept.) 1922; abstr. D. Cosmos, 65:784 (July) 1923.

15. Hyatt, T. P.: Statistical Study of Location of Dental Caries, D. Digest, 34:235-243 (April) 1928.

as they presented themselves, and no selection was made because of the mouth conditions. It is felt that this group can serve as examples of mouth conditions of the children of Minneapolis. The data recorded for each child included name, date, age, sex, race and father's occupation. The teeth were recorded as perfect, filled, carious, impacted, abscessed root, extracted, lost or congenitally missing.

The data were divided by age and sex and side of mouth. Since it was found that the difference between the teeth on the right and the left sides of the mouth was significant, the teeth of both sides were combined in this study. The age classification that was used groups all children between the ages of 4 years and 4 years 11 months in the 4 year class; etc.

TABLE 2.—PERFECT DECIDUOUS TEETH*

		Age in Years										
Tooth		2	3	4	5	6	7	8	9	10	11	12
Upper												
Central incisor	M	89	63	71	60	48	22	9	3	0	0	0
	F	86	69	62	62	54	16	4	4	1	0	0
Lateral incisor	M	93	80	85	74	66	56	26	10	1	0	0
	F	89	79	74	79	73	36	17	10	1	0	0
Cuspid	M	92	91	85	86	80	75	67	58	48	27	12
	F	96	91	87	86	80	77	67	60	32	19	23
First molar	M	79	68	65	56	42	30	30	21	15	8	2
	F	79	75	64	61	44	27	25	21	13	3	2
Second molar	M	57	37	30	34	29	26	18	19	15	10	8
	F	70	42	32	38	29	21	22	18	13	9	5
Lower												
Central incisor	M	98	97	96	90	46	14	4	3	0	0	0
	F	98	99	95	80	39	4	3	2	1	0	0
Lateral incisor	M	93	96	96	98	71	42	15	4	0	0	0
	F	100	98	95	94	68	24	5	2	1	0	0
Cuspid	M	94	95	89	87	81	78	69	54	30	13	5
	F	94	89	70	85	84	77	60	45	15	5	2
First molar	M	78	56	35	38	22	22	19	12	10	8	2
	F	78	60	45	38	26	21	18	15	6	6	0
Second molar	M	68	29	24	17	20	19	14	11	12	8	1
	F	53	32	20	21	15	14	13	13	4	2	2

*All figures are expressed as percentages.

Table 1 represents the sex and age distribution of all the children studied.

General summary tables showing in percentages the conditions of each deciduous tooth for each age and sex in children, from 2 to 12 years of age, are presented in Tables 2 to 5. Similar

tables for conditions of the permanent teeth in children ranging in age from 5 to 15 years of age are presented in like manner in Tables 6 to 9 inclusive. From this set of tables, the likelihood of any particular tooth condition at any age level may be determined.

For example, in Table 2, which represents the percentage of deciduous perfect teeth at any given age under consideration, it will be noted that at 3 years of age, the lower second molar is found to be perfect in only 29 per cent of the teeth of the male and the same tooth is perfect in but 32 per cent of all the teeth present in the female. At 4 years of age, the percentage of the perfect lower second deciduous molars is reduced to 24 per cent in the males and to 20 per cent in the females.

It will be noted that the upper and lower first permanent molars are early affected by caries. At the age of 10 years, only four years after their eruption, ap-

TABLE 3.—FILLED DECIDUOUS TEETH*

Tooth		Age in Years										
		2	3	4	5	6	7	8	9	10	11	12
Upper												
Central incisor	M	0	2	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0
Lateral incisor	M	0	1	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	2	0	0	0	0	0	0
Cuspid	M	0	0	0	0	0	2	1	2	2	0	1
	F	0	0	1	0	1	0	3	2	0	1	0
First molar	M	1	0	0	2	1	4	2	3	0	2	1
	F	0	1	1	3	4	2	4	7	1	0	0
Second molar	M	0	4	5	6	6	9	9	8	5	4	1
	F	0	0	6	5	6	7	12	11	11	3	1
Lower												
Central incisor	M	0	1	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0
Lateral incisor	M	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0
Cuspid	M	0	0	0	1	0	1	3	1	0	0	1
	F	0	0	0	0	0	1	1	0	0	0	0
First molar	M	1	0	3	5	5	4	5	3	2	2	1
	F	0	3	4	5	6	5	5	9	2	0	0
Second molar	M	3	4	4	13	7	3	5	6	0	4	0
	F	1	2	6	8	10	10	9	6	8	1	0

*All figures are expressed as percentages.

proximately 80 per cent of the lower molars and 70 per cent of the upper molars are defective. (Table 6.) One may readily see that, if the profession is to attempt keeping these teeth in a healthy condition, prophylactic measures must be instituted early, which means soon after they are erupted. It will also be observed that the lower cuspid is least likely to become defective, as compared to the remainder of the teeth, 98 per cent being perfect at 15 years of age.

The deciduous teeth are frequently affected by dental caries soon after their eruption. The lower second deciduous molar was found to be carious, filled or infected in 70 per cent of the teeth examined in children 3 years of age. (Table 2.) The upper second molar shows defects in approximately 60 per cent of the teeth examined in children at the age of 3 years. This tooth is normally lost at about 11 years of age. One can easily see that if this tooth is not given early atten-

TABLE 4.—DECIDUOUS TEETH WITH CAVITIES*

Tooth		Age in Years										
		2	3	4	5	6	7	8	9	10	11	12
Upper												
Central incisor	M	10	32	24	31	30	8	5	0	0	0	0
	F	11	30	33	30	19	12	1	0	0	0	0
Lateral incisor	M	5	17	12	23	26	11	4	3	0	0	0
	F	7	19	23	18	17	10	2	1	0	0	0
Cuspid	M	6	8	15	12	19	18	25	30	20	10	3
	F	0	9	11	12	19	22	23	19	16	5	4
First molar	M	19	26	30	32	40	43	36	25	13	3	2
	F	20	23	31	30	42	46	34	22	12	3	0
Second molar	M	28	55	61	55	51	49	44	32	24	5	7
	F	27	58	59	53	55	48	38	36	18	11	3
Lower												
Central incisor	M	2	1	3	1	4	0	0	0	0	0	0
	F	1	1	3	2	4	0	0	0	0	0	0
Lateral incisor	M	4	2	4	2	14	4	1	0	0	0	0
	F	0	2	4	4	8	9	2	0	0	0	0
Cuspid	M	4	4	10	11	18	14	19	16	7	3	0
	F	5	11	9	14	15	17	15	7	6	1	0
First molar	M	18	39	55	42	50	40	33	20	12	6	0
	F	22	35	38	40	44	36	30	21	14	1	2
Second molar	M	18	58	56	54	48	40	27	21	16	8	2
	F	39	60	53	53	46	34	29	21	12	7	4

*All figures are expressed as percentages.

tion, it is very likely to become infected and lost many years before it normally should. The result is impaired mastication and possible malocclusion. The lower molars, both permanent and deciduous, are more frequently affected by caries than are the upper molars. In the remaining teeth, caries occurs more often in the upper teeth than it does in the opposing lower teeth.

The material was then divided according to sex. There were 1,372 males and 1,182 females in our study. Figure 1 represents a comparison of tooth conditions for males and females at various ages. The male is represented by the heavy line and the female by the dotted line. For the deciduous teeth, it will be noted that up to about the age of 6, there are slightly more perfect teeth among the females, but after the age of 6, the teeth of the males seem to be slightly better than those of the females. Also, the missing teeth of the female are slightly

TABLE 5.—MISSING DECIDUOUS TEETH*

		Age in Years										
Tooth		2	3	4	5	6	7	8	9	10	11	12
Upper												
Central incisor	M	1	2	5	6	20	70	86	96	99	100	100
	F	3	1	5	7	27	72	94	96	99	100	100
Lateral incisor	M	2	2	3	2	9	31	69	87	98	100	100
	F	3	2	2	2	8	53	79	89	98	100	100
Cuspid	M	2	0	0	0	1	4	5	10	30	61	84
	F	0	0	0	0	0	1	7	18	51	75	91
First molar	M	1	5	4	7	16	23	32	50	72	86	95
	F	0	0	3	5	9	24	37	49	74	94	
Second molar	M	15	4	3	5	14	20	29	40	55	79	83
	F	2	0	3	4	11	24	28	33	58	76	90
Lower												
Central incisor	M	0	0	0	8	47	86	96	98	100	100	100
	F	0	0	1	16	56	94	96	97	99	100	100
Lateral incisor	M	3	1	0	0	15	53	83	95	99	100	100
	F	0	0	1	2	24	67	93	98	99	100	100
Cuspid	M	2	0	0	0	1	6	8	27	62	83	93
	F	0	0	0	0	0	6	24	48	78	94	98
First molar	M	3	4	6	15	22	34	42	64	75	85	97
	F	0	1	12	11	23	37	46	54	77	92	97
Second molar	M	11	9	14	15	24	38	53	61	72	80	96
	F	5	5	18	17	28	42	48	59	75	87	94

*All figures are expressed as percentages.

TABLE 6.—PERFECT PERMANENT TEETH*

Tooth		Age in Years										
		5	6	7	8	9	10	11	12	13	14	15
Upper												
Central incisor	M	1	13	66	84	94	89	87	85	80	72	82
	F	1	23	71	91	94	84	89	79	70	69	63
Lateral incisor	M	0	4	13	54	75	83	84	77	83	73	85
	F	0	4	38	63	85	86	87	77	79	74	75
Cuspid	M	0	0	2	3	7	24	48	77	92	94	98
	F	0	0	4	5	14	44	66	89	91	96	96
First bicuspid	M	0	0	5	9	27	53	73	77	88	87	81
	F	0	0	6	15	30	58	78	87	82	83	71
Second bicuspid	M	0	0	3	6	12	35	58	62	79	73	76
	F	0	0	5	8	15	42	54	74	70	80	59
First molar	M	2	31	45	40	31	30	29	21	24	12	14
	F	6	44	43	38	38	29	28	25	24	27	25
Second molar	M	0	0	0	0	0	3	12	32	44	35	34
	F	0	0	0	0	1	6	21	49	48	48	46
Lower												
Central incisor	M	5	44	87	96	97	97	99	97	99	98	97
	F	13	60	95	97	96	95	99	99	96	100	96
Lateral incisor	M	0	13	52	81	96	98	99	98	99	100	98
	F	1	20	66	91	97	97	97	99	99	99	96
Cuspid	M	0	0	4	4	20	61	82	89	99	99	100
	F	0	1	5	17	40	75	92	99	99	98	96
First bicuspid	M	0	0	2	5	21	50	61	83	93	94	94
	F	0	1	4	9	24	59	77	88	88	93	83
Second bicuspid	M	0	1	2	4	10	31	42	59	74	78	76
	F	0	0	2	6	14	36	47	65	73	74	75
First molar	M	4	35	31	22	24	20	19	12	10	8	9
	F	9	29	36	23	23	21	21	14	13	16	17
Second molar	M	0	0	0	0	0	9	38	45	39	41	24
	F	0	0	0	1	3	18	47	54	32	34	33

*All figures are expressed as percentages.

fewer in number up to the age of 5 or 6 and from then on there is an increase over the percentage of missing teeth of the male. In the permanent teeth, the female seems to have slightly better teeth up to the age of about 13, at which time the record of the male becomes a little better than that of the female. The

TABLE 7.—PERMANENT TEETH FILLED*

Tooth		Age in Years										
		5	6	7	8	9	10	11	12	13	14	15
Upper												
Central incisor	M	0	0	0	0	0	0	0	0	6	6	4
	F	0	0	0	0	0	1	0	1	1	0	4
Lateral incisor	M	0	0	0	0	0	0	1	1	4	5	5
	F	0	0	0	0	0	1	1	5	3	0	4
Cuspid	M	0	0	0	0	0	0	1	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	1	0
First bicuspid	M	0	0	0	0	0	0	2	2	3	5	6
	F	0	0	0	0	0	0	0	3	3	4	12
Second bicuspid	M	0	0	0	0	0	0	0	1	4	4	5
	F	0	0	0	0	0	0	0	3	1	4	20
First molar	M	0	0	2	6	11	10	26	29	38	41	42
	F	0	1	3	9	10	18	23	22	23	30	38
Second molar	M	0	0	0	0	0	0	0	1	3	12	13
	F	0	0	0	0	0	0	0	3	4	5	4
Lower												
Central incisor	M	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0
Lateral incisor	M	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0
Cuspid	M	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0
First bicuspid	M	0	0	0	0	0	0	0	0	0	0	2
	F	0	0	0	0	0	0	0	0	0	1	2
Second bicuspid	M	0	0	0	0	0	0	0	1	4	4	7
	F	0	0	0	0	0	0	0	3	1	5	12
First molar	M	1	0	3	7	14	14	21	27	37	34	35
	F	0	1	2	13	16	16	24	23	16	17	21
Second molar	M	0	0	0	0	0	0	0	1	16	12	23
	F	0	0	0	0	0	0	0	1	7	7	4

*All figures are expressed as percentages.

males have more filled teeth, the females have more cavities and the males have more missing teeth up to the age of 13; after which, the teeth are about the same for both sexes, with a very slight tendency for more missing teeth among the females.

The material was then arranged ac-

TABLE 8.—PERMANENT TEETH WITH CAVITIES*

Tooth		Time in Years 5	6	7	8	9	10	11	12	13	14	15
Upper												
Central incisor	M	0	0	0	2	4	10	11	13	11	21	12
	F	0	0	0	2	3	15	10	16	25	29	29
Lateral incisor	M	0	0	0	1	4	11	13	18	10	19	9
	F	0	0	1	1	2	11	8	15	14	26	12
Cuspid	M	0	0	0	0	0	0	1	0	0	2	1
	F	0	0	0	0	0	0	0	0	3	3	4
First bicuspid	M	0	0	0	1	3	4	6	7	6	6	10
	F	0	0	0	0	3	4	7	6	12	10	17
Second bicuspid	M	0	0	1	0	2	3	7	12	8	15	14
	F	0	0	0	0	2	3	6	10	16	6	20
First molar	M	2	14	46	53	58	54	35	41	31	36	33
	F	5	26	44	52	43	42	40	38	34	31	29
Second molar	M	0	0	0	0	0	3	11	24	32	44	48
	F	0	0	0	0	1	3	11	19	37	31	33
Lower												
Central incisor	M	0	0	0	0	2	3	0	2	0	0	2
	F	0	0	0	0	2	4	0	0	2	0	4
Lateral incisor	M	0	0	0	0	0	0	1	1	0	0	0
	F	0	0	0	0	1	2	0	0	1	1	4
Cuspid	M	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	2	
First bicuspid	M	0	0	0	0	2	2	2	2	1	3	2
	F	0	0	0	0	3	2	3	6	8	5	17
Second bicuspid	M	0	0	0	2	2	3	9	8	7	11	10
	F	0	0	1	1	2	3	10	12	13	11	12
First molar	M	2	25	60	61	59	56	45	44	35	24	29
	F	8	42	55	59	53	45	34	48	33	29	33
Second molar	M	0	0	0	0	0	6	19	36	41	39	48
	F	0	0	0	0	0	7	15	33	54	53	47

*All figures are expressed as percentages.

cording to the race of the family. Of the 1,997 children on whom racial data were available, 1,109 were Jewish and 888 non-Jewish. The results of this analysis are found in Figure 2. It will be noted that the condition of the deciduous teeth in the non-Jewish children up to the age of 6 or 7 is much better than that of the

TABLE 9.—MISSING PERMANENT TEETH*

Tooth			Age in Years										
			5	6	7	8	9	10	11	12	13	14	15
Upper	Central incisor	M	99	86	33	14	2	1	0	0	1	0	2
		F	98	77	28	6	2	0	0	1	3	2	4
	Lateral incisor	M	99	96	87	45	21	6	1	2	1	2	0
		F	100	96	60	35	12	2	1	2	3	0	0
	Cuspid	M	100	100	98	97	93	75	50	21	7	4	0
		F	100	99	96	94	86	53	33	10	6	1	0
	First bicuspid	M	100	100	95	90	70	44	19	13	2	2	3
		F	100	100	93	85	66	37	14	3	2	3	0
	Second bicuspid	M	100	100	96	94	86	62	35	24	8	7	5
		F	100	100	94	92	82	54	39	12	7	10	0
	First molar	M	96	55	7	1	0	6	6	3	6	11	11
		F	88	40	9	1	2	2	4	8	13	8	8
	Second molar	M	100	100	100	99	100	93	76	43	19	8	4
		F	100	100	100	99	97	91	67	28	10	11	12
Lower	Central incisor	M	95	56	13	3	1	0	0	0	0	0	0
		F	87	40	5	2	1	0	0	2	0	0	0
	Lateral incisor	M	100	87	48	19	4	2	0	0	1	0	1
		F	99	80	33	9	1	0	0	0	0	0	0
	Cuspid	M	100	99	96	96	80	39	18	11	1	1	0
		F	100	99	94	83	59	24	7	0	1	0	4
	First bicuspid	M	100	100	98	95	77	47	37	15	5	2	1
		F	100	99	95	91	73	38	19	6	3	0	0
	Second bicuspid	M	100	99	98	94	88	66	48	28	15	6	6
		F	100	99	96	92	84	60	43	20	11	9	0
	First molar	M	92	40	6	3	2	10	15	17	17	34	26
		F	83	27	6	4	7	17	20	13	37	37	27
	Second molar	M	100	100	100	100	99	84	43	18	4	8	4
		F	100	100	100	99	96	75	37	12	6	3	16

*All figures are expressed as percentages.

Jewish children, and from then on they seem to be almost identical. The permanent teeth in the non-Jewish children seem to be a bit better in the early ages; and, in the later ages, the teeth of the Jewish children seem to be a little better.

The data were then treated according to the socio-economic position of the family.

For determining the socio-economic

SMOOTHED CURVES COMPARING CONDITION OF TEETH OF MALES AND FEMALES.

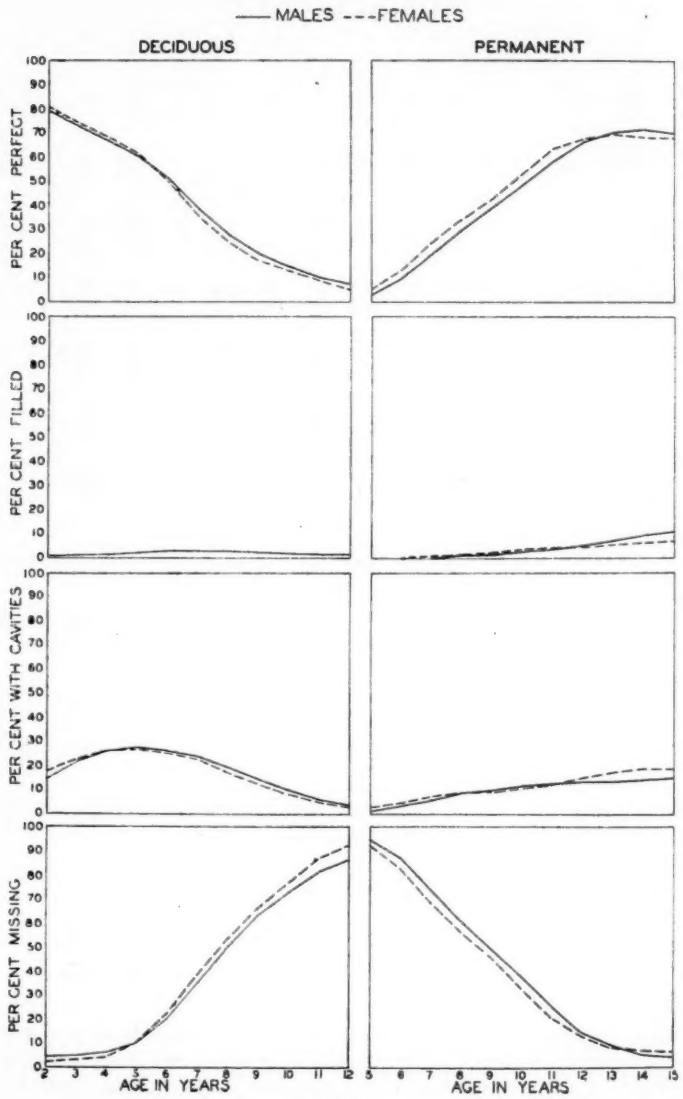

Figure 1

SMOOTHED CURVES COMPARING CONDITION OF TEETH OF JEWISH AND NON-JEWISH CHILDREN

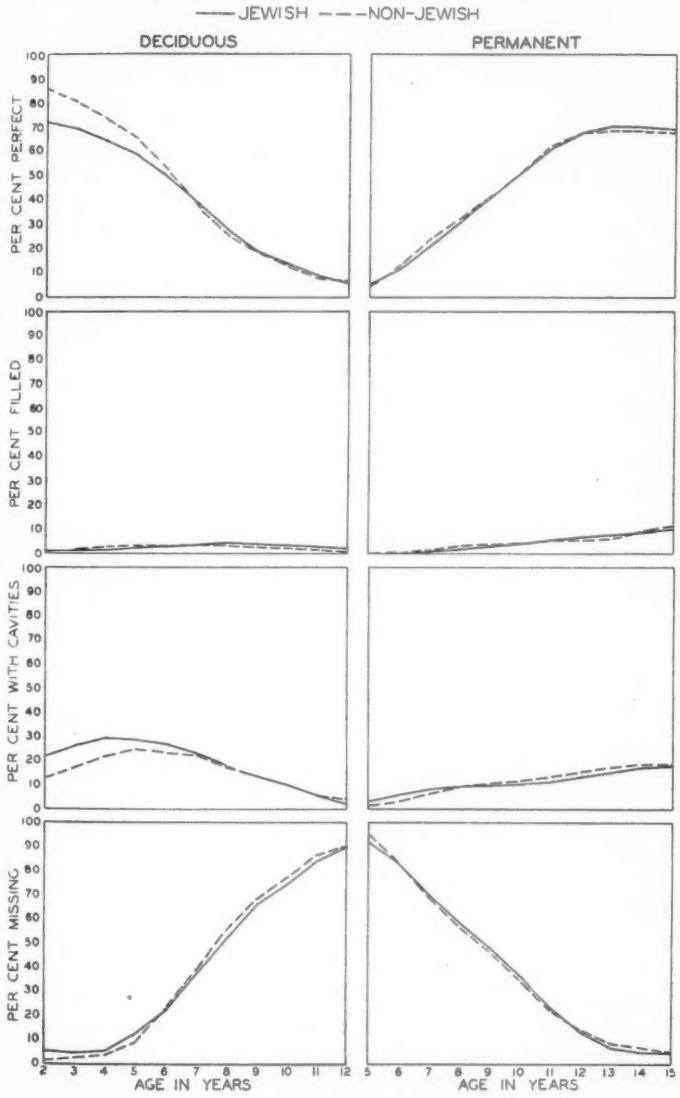

Figure 2.

SMOOTHED CURVES COMPARING CONDITION OF TEETH OF CHILDREN IN UPPER AND LOWER SOCIO-ECONOMIC CLASSES

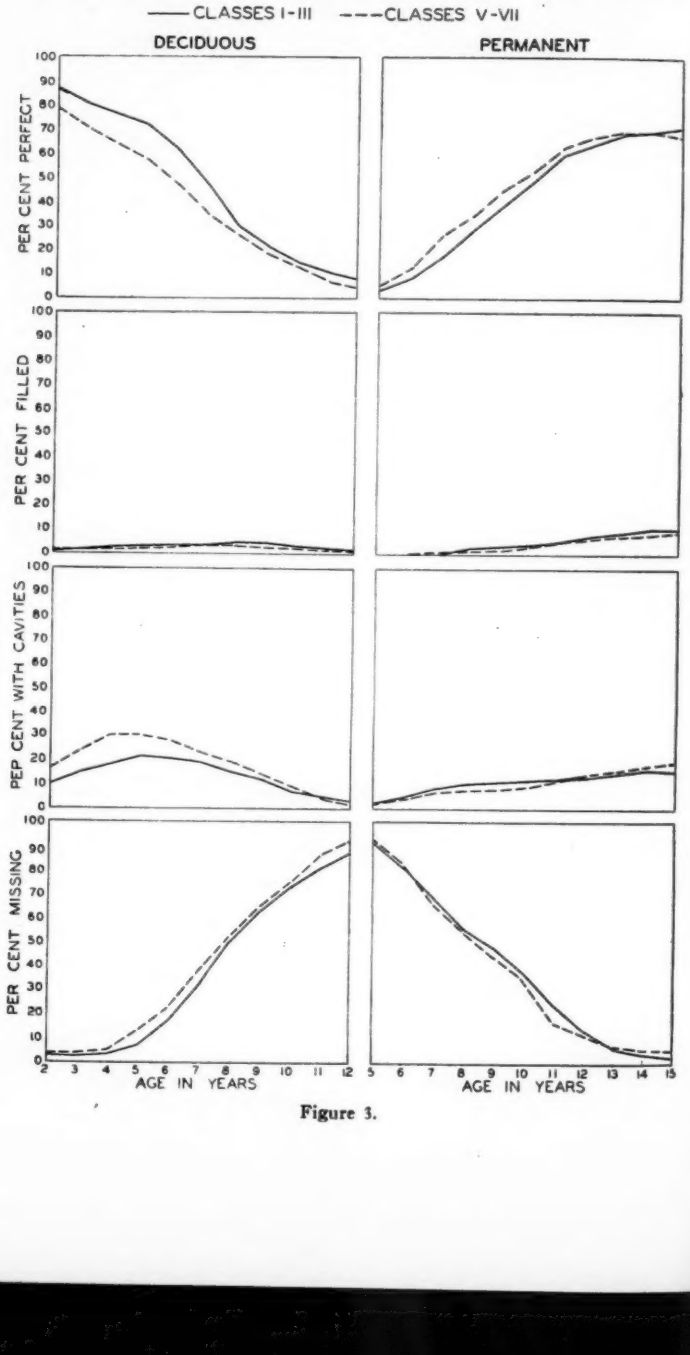

Figure 3.

level to which a given child should be assigned, the method of Professors Goodenough and Anderson was utilized, a method which determines socio-economic status through the occupation of the family's chief wage earner, the father.

Goodenough and Anderson[16] list all occupations in the country as given in the United States census and divide them into groups as follows:

Group I. Professional.

Group II. Semiprofessional and managerial.

Group III. Clerical, skilled trades and retail business.

Group IV. Farmers.

Group V. Semiskilled occupations, minor clerical positions and minor business.

Group VI. Slightly skilled trades and other occupations requiring little training or ability.

Group VIII. Day laborers and all other classes.

For the purpose of this study, occupations I, II and III have been combined and called the upper group; and occupations V, VI and VII have been combined and called the lower group. Since we were working with a city population, no farmers or members of class IV were available. While these divisions may seem somewhat arbitrary, this scale for classifying occupations has been widely used by psychologists and sociologists to indicate the socio-economic level of a given family.

Figure 3 represents a comparison between the conditions of the permanent and deciduous teeth of the higher and lower socio-economic classes. These data were available for 1,437 of the children studied, 525 falling into the higher socio-economic group and 912 falling into the lower socio-economic group. The heavy line represents children who come from the higher socio-economic group and the dotted line those who come from the lower socio-economic group. It will be noted that the children from the higher classes socially seem to possess much better deciduous teeth; while the children from the lower socio-economic groups possess better permanent teeth up to the age of 14 years. Similar results for socio-economic status were obtained when the males and the females of both groups were compared separately. Hence, this relation seems to be general and independent of sex.

16. Goodenough, F. L., & Anderson, J. E.: Experimental Child Study, New York: Century Co., Vol. 12, 1931.

CONCLUSIONS

1. Figures showing the relationship of the conditions of both deciduous and permanent teeth to age indicate that there is wide variation in the teeth with respect to the appearance of cavities, the filling of the teeth and the loss of teeth.

2. Females have slightly better permanent teeth than do males up to about 13 years of age.

3. Children who come from families of the higher socio-economic groups have better deciduous teeth, but the permanent teeth of children who come from the lower socio-economic groups are better.

4. The deciduous teeth of non-Jewish children are better up to the age of 6 years, and from that age on the condition of the teeth in the non-Jewish and Jewish groups appear similar. The permanent teeth of the Jewish children seem to be in slightly better condition after the age of 12 years.

5. Approximately 80 per cent of the lower first permanent molars are defective by 10 years of age.

6. Seventy per cent of the second lower deciduous molars are defective in the average child of 3 years of age.

DENTAL ECONOMICS

THE WAY OUT OF ECONOMIC CHAOS*

By ROSS GARRETT,† Washington, D. C.

OUR country is full of sincere people who are looking for the way out for us. In order to find the way out for some one else, one must have some degree of technical knowledge, some skill, some training of an applied nature back of their sincerity. I compare the activities of some of our well-intentioned welfare workers who are endeavoring to point the way out for us in things of medical nature with those of people who, when an accident occurs in the street, rush pell mell to the aid of the injured and out of compassion and sympathy and a desire to do something for him, actually do the very things that are most damaging.

In the instance of medical economics, the people who are unable to pay for adequate service are analogous to the victim of the accident in the street, and the welfare workers who are endeavoring to work out cure-all schemes variously termed state medicine and health insurance are analogous to the well-intentioned and compassionate bystanders who rush into the street to assist the injured. The physician who arrives on the scene after the accident has happened and brusquely starts shoving the sympathetic crowd away from the patient, with terse comments to the effect that they are actually doing the subject of their compassion harm, is analogous to organized medicine and dentistry in its attitude toward these cure-all schemes proposed by the well-intentioned sociologists. After all, the physician, having arrived on the scene, is prepared to take over the care of the patient and is in a much better position to know what to do and how to do it than the well-intentioned bystanders; but the well-intentioned bystanders resent his late arrival and his abruptness in telling them that they are not capable of doing the best thing for the patient, and naturally hard feelings develop on the part of the well-intentioned bystanders, who, after all, had no intention of harming the patient, but actually desired to aid him in the absence of available trained help.

I trust that any comments made during the course of my address, which apply to social workers or their kindred, will be interpreted in line with the picture that I have just presented. I do not doubt the sincerity of these people in their endeavors to solve a sick nation's medical-economic problems. I do doubt their technical ability to do anything more than actually make worse the situation and the condition which they are essaying to improve. I do believe that competent trained aid is now coming to the assistance of the patient in the form of an aroused and awakened organized medical and dental fraternity; and I do believe that the problems of medical economics can and will be solved to the best interests of the American public as a consequence thereof.

*Read at the Third General Meeting of the Seventy-Seventh Annual Session of the American Dental Association, New Orleans, La., Nov. 6, 1935.

†Coordinator of the Medical Economic Security Administration of the District of Columbia.

I personally became involved and interested in the field of medical economics as a result of engaging in adjunctive medical work in the West. Operating laboratory service in small towns for small hospitals and private physicians, as well as doing laboratory work for small town and municipal health departments, I was in close contact with all of the economic problems affecting the medical and dental professions, private and public hospitals, health departments and the people served by all of these.

After my advent into this successful field, the monkey wrench was thrown into the great national economic machinery and things started on a downward trend. On the heels of the depression came the natural result that hundreds of people were not able to provide for medical service and hospital facilities because of indigency.

At that time, I was instrumental in devising a plan whereby those of indigent status might be cared for by any physician of their choice who was a member of a county medical society, compensation for the service rendered being made directly to such societies instead of to an individual county physician and his assistant.

After working with politicians and well-intentioned but uninformed persons in an attempt to institute such a program of providing adequate medical care to all indigent citizens, at the same time protecting the individual physician-patient relationship and doing away with regimentation, I soon recognized that only those people who had some technical knowledge of how to help the patient should endeavor to administer aid. I became imbued with the idea that the people who have good intentions should lend only their sympathy and those good intentions, but not give more than that lest they cause further injury to the patient.

Watching the involved red tape systems that thwarted all endeavors at adequate care through simple methods, I could see the handwriting on the wall and I realized that this was not an emergency that was going to be met overnight, but a chronic situation that might revert to anything.

The PWA system schooled me in my first amateur interpretation of state medicine. Under the CWA system, a federal fee schedule was set up. In most cases, the fees were so low that they would not even pay for upkeep of modern equipment and a high standard diagnostic service. In order to obtain these low fees, "Chinese puzzle" red tape reports had to be made out, requiring the employment of extra help. After these reports were made out, a clerk who probably did not understand the nomenclature of medical work sent the reports back with the notation that they had been signed in the wrong place or were improperly filled out in some manner. In many instances, this procedure occurred several times. Finally, a check would be received disallowing a wholesome portion of the claim, with the admonition that the funds were low and disallowance was necessarily made of a portion of the claim. From this, I gained some intimation of what state medicine would be like. Nobody had ever consulted us regarding what our fees had to be in order to maintain an establishment and turn out high-grade work in diagnosis. Yet we were obligated to turn out high standards of work in accordance with the fees which were set by somebody else.

With the realization that medical economics was rapidly presenting a problem which could not be solved overnight, I severed my active connection with the work in which I was engaged and became whole-heartedly interested in attacking the problem of medical economics in a practical way.

I obtained a position in the District of Columbia as health secretary of the Council of Social Agencies, which maintained a health committee that had to do with planning health work for the city of Washington, D. C. One of the first appalling conditions that I encountered was the fact that this committee was constituted of social workers and lay executives representing a multitude of health agencies with practically no representation of physicians and dentists. One of the most important subcommittees of this health committee was one constituted of medical social workers, who were in charge of the dispensaries and clinics of the private hospitals. The clinics were overcrowded owing to an increase in the number of indigents, and the contention on the part of the medical profession was that in the building up of the clinic system, many people in the District were not properly advised as to the real purpose of these clinics, and, as a consequence, many people who could pay were crowding the clinics and obtaining the advantages that should be restricted to those of indigent status.

Working with the District of Columbia Medical and Dental Societies, we started a study of the situation as regarded medical economics and the provision of adequate medical care from a very simple and basic standpoint. Committees on coordination of resources for medical care were established in both societies and, by virtue of their studies and their activities, the Medical Economic Security Administration of the District of Columbia was formed. The first unit of this Administration was called the Central Admitting Bureau for Hospitals. The administration of this unit was controlled by the medical and dental professions themselves, which encompass the services of the only people who have anything to give and who have given of their service for years without any waving of banners and, without any acclaim or applause, that only essential commodity which is involved, their personal skill and experience. Through the Central Admitting Bureau for Hospitals, a clearing house was established which determined the social-economic status of all persons in the District of Columbia who were worthy recipients of free care in the clinics and the free wards of the community private hospitals, as well as the public hospital. On the basis of the experience obtained through the first month of operation of this unit of the Medical Economic Security Administration, the committees on coordination of resources for medical care of the medical and dental societies evolved for themselves a new elementary principle of medical economics upon which to base their future activities in an attempt to provide adequate medical care of all persons in the community. It was the belief of the committees that in the field of general economics, too much ingenuity was being injected in the form of top-heavy machinery; which ultimately would result in the tail wagging the dog. Most of the ingenious schemes that have been proposed in the field of general economics smack of an endeavor to prove that the best way to overcome an obstacle is by going around that obstacle; in other words, trying to prove that two and two can be made to make five. It was the committee's belief that instead of trying to operate on the basis of making two and two make five, just half the effort expended in an endeavor to prove that two and two still can be made to make four would assure more satisfactory results.

Attacking your problem from the standpoint of schoolboy economics, we revert to that late era of prosperity in which the United States was the richest country in the world and had more cash

than any other country in the world and more natural resources per unit of population than any other country in the world. Almost overnight, the normal machinery that adjusted the American people to that money and to those resources was disrupted, and, as a result, millions of people started to become maladjusted to that money and those resources. Dollar for dollar, the same amount of money and the same resources exist in this country today as existed at that time. The money was not thrown into the ocean nor destroyed. What actually happened was the result of inability of normal existing economic machinery to entirely and capably handle a newly created abnormal condition.

In the field of medical economics, let us assume that we have a sliver off the big tree of general economics. At that same time of prosperity, the United States had the highest standard of medical and dental service of all countries in the world, had more physicians, more dentists, more nurses. It had more hospital beds per unit of population than any other country in the world.

Yet almost overnight, many of our people became maladjusted to meeting their needs for the service of physicians and dentists and hospitals.

We said, "Let us be really elementary. We have been hearing so much about economics, in flowing phrases, and, after all, economics, boiled down to the essence, is simply common sense."

Let us say that you have an automobile for the purpose of adjusting yourself to transportation. One day, you find something wrong with the machinery which adjusts you to your transportation. Not being an expert and not having assembled this machinery, you step on the starter and look under the hood. Time goes by and you become upset because you are not able to start your machine. Becoming disgusted, you might say, "I want somebody to give me a new automobile. I am going to junk the old one. It is no good. Yesterday, it was all right. Today, there is something wrong with it, so I'm going to junk the whole thing."

Yet are not all the new autos you might replace the junked one with as liable to have something wrong with them the next day as the one you discarded because it wasn't entirely and immediately capable of adjusting you satisfactorily to your transportation needs?

Instead of junking the car, why not see if we cannot adjust the machinery so that it will do the job it once did? There may yet be much good in the old chassis of our present economic system. We have only a comparatively few miles on it. The tires may need replacing. Perhaps it is only the carburetor that needs adjusting. It is usually one of the little, but vital, details that makes machinery faulty. Suppose you call in theoretical experts to tinker with the stalled car, and employ mechanics who have revolutionary ideas that they wish to apply to the stalled car of economics. Perhaps for several years, because business was good, nobody gave them a chance to tinker with a real automobile, but they have always had the idea in the back of their heads that if you took the two hind wheels and two front wheels off and put bicycle wheels behind and roller skates in front, the car would run much better.

The committees on coordination of resources of the two societies of the District of Columbia definitely learned from the first two months' operation of the Central Admitting Bureau for Hospitals (which was the result of their first experiment to determine whether there might be some good left in the chassis of existing medical economic machinery) that by coordinating existing resources in community hospitals and placing control

over admission of ward patients of indigent status and the crowded clinics of the public and private hospitals, a large percentage of the people could be readjusted to share a goodly portion of the economic responsibility for their hospital care themselves and also that a greater amount of medical service might be provided to those who were worthy and in need of it. From the operation of this first unit of the Medical Economic Security Administration, the medical society and dental society did learn that the old machinery was still capable of handling its routine job and, further, was capable of handling an abnormal job created by virtue of abnormal economic conditions, simply through creation of a few elements of abnormal machinery to augment already existing machinery and through coordination of all exisiting community machinery to accomplish the readjustment of those of indigent and semiindigent status to the requisite hospital inpatient and outpatient facilities without destroying any of the original principles of medical economics and medical care and replacing them with an entirely new piece of machinery.

The committees did learn that it did not take some new and peculiar type of intellect to create the machinery which they had created in this first unit of what they termed the Medical Economic Security Administration of the District of Columbia, and the committees did learn that there was sufficient intellect and integrity apparent within the confines of the medical and dental societies to create adjusting machinery and demonstrate the fact that organized dentistry and medicine still are and can continue to be the protectors of the health and lives of the community without the extraneous aid of sympathetic, misguided and unqualified theorists.

The committees, becoming imbued with the belief that medical economics was not a matter of academic theory but of practical application of simple principles of coordinating all existing resources to fill an existing demand (and, when that demand became abnormal, to create somewhat abnormal, but nevertheless merely adjunctive, machinery), proceeded, with intent and systematic thought, to create additional abnormal, but still adjunctive, machinery to readjust the people of all incomes, but not indigent in status, to meet their needs for medical, dental and hospital services and facilities.

As a result, the medical and dental societies created the Medical-Dental Service Bureau, as the second unit of the Medical Economic Security Administration. The Medical-Dental Service Bureau was financed and is owned by the medical and dental societies of the District of Columbia. The purpose of this piece of abnormal machinery was to make it possible for all wage earning or static or limited income citizens to pay for the medical and dental service which they received and for these static or limited income people to get what they paid for in accordance with their individual ability to pay for it. A single piece of machinery was created whereby every individual person, as far as any ramification of medical hazard might exist, but where an attendant economic equation also existed, could have that economic equation solved and adjusted to their individual abilities to pay.

We realized at the outset that human beings cannot be sorted out like so many potatoes, apples or onions. We realized that there are no two people who have exactly the same social, economic and medical problems and equations. We recognized that the majority of the American middle class of static and limited incomes are fundamentally honest

and wish to pay for what they get and get what they pay for, that their only cry is that they be permitted to pay in accordance with their ability to pay.

We realized that the great American middle class had been educated to buy all of the necessities and many of the luxuries of life on the installment plan, to include in their limited and static incomes a budget whereby it would be possible for them to have the necessities and some of the luxuries which they desired, and to have them at the moment, but pay for them on the installment plan. We realized that the great American middle class of static and limited incomes had never been educated to systematically anticipate their health protective needs and follow the same budgetary procedure in anticipation of these needs.

We realized that the possibility of illness or dental pain is a remote one to a healthy person. We realized that radios are things which every American middle class person of static and limited income desires to have, but that appendectomies, tooth extractions, etc., are not. We recognized that the great American middle class of static and limited income can and should be educated to include in their budget something to defray the expense of the care which they have had to obtain when health hazards do occur, placing the need for this service on a parity at least with the need of a radio, a washing machine and the like. We realized that a long neglected educational job must be undertaken. We realized that this educational job must be undertaken regardless of what type of machinery anybody should ever institute to adjust these people to meet their medical needs.

We recognized that all of the socialistic schemes which have been proposed constitute class legislation because they do not make it possible for all of the nonindigent but static and limited incomed citizens to be adjusted economically to meet their medical needs. We recognized that the Administration's unemployment insurance program under the Social Security Act does not propose to protect domestic servants, red cap porters, taxicab drivers, small business men, barbers in business for themselves with one or two other barbers working for them or the barbers working for this one barber, individual stenographers or any of the other classes that make up a host involving millions of limited and static income American middle class citizens against the hazards of possible unemployment.

We recognized also that proposed health insurance schemes fell in the same category, because people had to be employed in some numbers and by some organization from which money could be obtained by the deduction method. We recognized at the outset that any system which we set up in the form of a medical-dental service bureau to make it possible for the middle class people of static and limited income to budget for their medical and dental and hospital needs must be all-inclusive and make it possible for *all* middle class people of static and limited income to utilize the system and thereby be adjusted to their medical, dental and hospital needs.

Consequently, the facilities of the Medical-Dental Service Bureau were thrown open to all employed persons regardless of their type of employment or their degree of income, as long as they were gainfully employed and nonindigent or semiindigent (a status which would automatically cause them to be handled by the first unit of the Medical Economic Security Administration, the Central Admitting Bureau for Hospitals).

The Medical-Dental Service Bureau machinery, owned and controlled and operated by the medical and dental societies of the District of Columbia, made it pos-

sible for all persons in the District of Columbia of static and limited income who have medical or dental needs and who have insufficient money to pay for them at the time to be referred to the Bureau by their physician or dentist and there have worked out for them, with the aid of trained budget consultants, a method of budgeting for their needed treatment, the cost of which is to be paid over a period of time.

We believed at the outset that about 80 per cent of the people who fall in the static and limited income group have routine or normal medical hazards. By routine or normal medical hazards, we mean the major hazards, such as appendectomies, complete extractions, etc. Contrary to the propaganda broadcast through the nation recently, people of static and limited income, as well as all others, do not have major illness day in and day out just as they have need for food, clothing and shelter day in and day out. The major medical hazards which befall about 80 per cent of our people are very sporadic in nature. The need for a major illness or operation or medical aid, for about 80 per cent of our people, including the limited and static income class, occurs at infrequent intervals. You do not have your appendix out every six months or every year. You do not have all of your teeth extracted and plates made every six months and every year throughout your life. You do not have diphtheria every six months nor pneumonia every ten months. The major vicissitudes and hazards of medical care are routine for about 80 per cent of our people, and for this 80 per cent who only have major and expensive medical hazards at periodical intervals, the method of budgeting the payments over a period of time following their need is one which will work out very well.

The other 20 per cent of the people fit into two subgroups. Let us say that from 5 to 18 per cent of the people are those who have subnormal medical hazards; for example, the man who, with great pride, says, "I have every tooth in my head, and I have had but very little dental care. I don't believe I have ever had occasion to spend more than $10 for a dentist in the forty years of my life." For the person also who says that he has never been in a hospital except to help carry in a man who has been in an accident, i.e., for the person who has subnormal hazards, and perhaps in a period of from ten to fifteen years only one major hazard, certainly we can say that the method of budget payments to clear up his obligation on the installment plan will meet his needs quite satisfactorily. The other 3 to 5 per cent (the percentage depending on whether you are a radical or a conservative statistician) fall into the catastrophic group. These are the people who have more than the normal or routine amount of medical hazards, represented by the family or the individual in the family who has one break of hard luck after another and an enormous medical expense.

There is no budget system, of course, which can distribute this expense over a period of time. It is really for this group, which is small in percentage, that all of these insurance schemes are proposed. Our belief at the outset was that if we could provide, by this budget method, to take care of the routine and normal medical hazards of from 95 to 98 per cent of the people, we would go a long way toward utilizing all available and existing resources without enslaving the entire practice of medicine and dentistry. The Medical-Dental Service Bureau constituted the machinery of the medical and dental societies to accomplish the job of working out a budget and installment basis of payment for routine and normal medical hazards of the static and lim-

ited income, or middle class, patients.

The response of the static and limited income class to this system as created and operated by the medical and dental societies in the District of Columbia has been spontaneous and unanimous in approval. As an indication of approval on the part of this class, I cite a result of the publicity which appeared in the local papers at the time the Medical-Dental Service Bureau, patterned after the one in the District of Columbia, was opened in St. Louis. Following the announcement of the opening of the Bureau by the societies in St. Louis, letters were received from numerous people giving approval of the system. I read a typical letter:

> I am a married woman and my teeth are in terrible condition. My husband and I have tried for the past two years to try and find some way to get my teeth fixed, but it just seemed impossible.
>
> Your way of getting this work done on time payment plan is wonderful and I hope that when I come to your office I will be accepted.
>
> My husband makes $22.50 a week and we could only pay $2.00 or $3.00 a week.
>
> Please let me know if this is somewhat satisfactory.
>
> My husband works for————and has been there nine years.

We estimate that about 37 per cent of the middle class would avail themselves of an opportunity to have needed work done, if machinery such as that provided by the Medical-Dental Service Bureau, the second unit of our Medical Economic Security Administration in the District of Columbia, were provided; the people going to their individual dentists, with a private personal contact, and adjusting themselves to their needed medical and dental care with the knowledge that every cent of the money they spend actually pays for service they get.

Contrast this system whereby the static and limited income class gets what they pay for and pay for what they get in accordance with their individual circumstances and ability to pay and whereby every penny actually goes to pay for service with the proposed red tape and standard breaking bureaucratic systems which are held forth as the only way out of medical economic chaos, whereby the individual patient as previously described applies to a politically appointed clerk who sits behind a desk with Rule Book 54 in his hand and, turning to page 57, says you must fill out two yards of purple form No. 6 and you can take that to the dentist, and the dentist will make an estimate of the amount of work to be done, then you will bring this form back for an O.K., and whether you should have that amount of work done will be determined and whether you are entitled under this system of insurance to have this amount of work done. Then, provided the politically appointed clerk is in the proper frame of mind, the patient is ordered to take the approved red tape form back to the dentist who, in turn, after doing the work, must complete Red Form 69X, and send it along with a carbon copy of this or that to Board No. 12, who, in turn, turns it over to Supervisor Number 26 to report back and find out whether the claim should be allowed, and, after all of this red tape has been gone through, provided there is enough money left after paying all the salaries and administrative overhead and rent for the upkeep of all of the previously mentioned monkeyshines, the dentist's bill may or may not be allowed.

During the first six months' operation of this Medical-Dental Service Bureau, more than 8,000 static and limited income (middle class) people were referred by physicians, dentists and hospitals and adjusted themselves to the needed serv-

ices and facilities of the installment payment plan. Cab drivers, red cap porters, domestic servants, shop girls, stenographers, small business men, all were accepted and all had budgets worked out for them and started paying on the installment plan. Of over $85,000 that these static and limited income people have paid, only 1.6 per cent has not been paid promptly on the agreed upon time and basis, and there are no persons that are behind more than two payments, in spite of the fact that many of them have had a great deal of trouble. I repeat that over 80 per cent of these members of the static and limited income class have routine hazards which do not recur and which they can clean up over a period of time before another one occurs. No charge of any kind is made to the individual patient. Every penny that they can afford to budget is utilized in the payment for the actual service.

For the maintenance of the Bureau, which is nonprofit, and cooperatively maintained by the medical and dental society members, 10 per cent of each payment made is retained to cover operating expense. As the volume of business and payments increased, the amount retained exceeded the amount necessary to meet the overhead. The surplus was placed in reserve, and from this is drawn the money to take care of the 3 to 5 per cent of cases which fall in the catastrophic class. To illustrate, let us take the case of a person who has started out with normal routine medical hazards and has made several payments on that basis and then has an increasing amount of medical hazard arise. The increased hazard is beyond the bounds of normalcy before referred to, and the patient is no longer able to keep up the payments necessary to defray his medical expense. When this occurs, the necessary money to defray the payments which he is no longer able to make is drawn from the reserve, thus taking care of his account.

What the physician, dentist and hospital actually do, by virtue of the method I have just described, is to leave 10 per cent of each payment that is made by their patients to cover the cost of making this service available and creating this machinery to supplant normal machinery which is no longer able to meet an abnormal situation, and, at the same time, assure themselves of the full payment of every account through establishment of the reserve, which is created from the difference between the actual amount used for overhead and the total amount created by leaving the 10 per cent with the Bureau.

Eight thousand borderline accounts of the static and limited income class who have received the best of medical, dental and hospital care, over $85,000 being involved in paying for the care which they received, and only 1.6 per cent of the people unable to live up to their obligations as agreed on and worked out with and for them by the machinery of the Bureau; care for those people who became overburdened by unforeseen catastrophies; and all accomplished by machinery owned, controlled and operated by the professions themselves without any help from militia, politicians or unlimited amounts of tax-provided money to operate and create administrative facilities. And the peculiar part of the whole summary is the fact that the greatest supporters of the entire project are the people, the static and limited income middle class who have been served.

In addition to this work of the Medical-Dental Service Bureau, the second unit of the Medical Economic Security Administration to be created as the way out of medical economic chaos by the societies of the District of Columbia, the results of the operation of the first eight

months of the Central Admitting Bureau for Hospitals, the first unit to be constructed for the Medical Economic Security Administration of the District of Columbia, show that occupancy in the private hospitals of Washington, D. C., has been increased 11.2 per cent over the occupancy of a like period of the prior year, 1934; and, at the same time, over $56,000 of community chest money which was used in 1934 to defray expenses of indigent or semiindigent persons in the clinics and wards has been expended. At the same time, occupancy in the public hospital has decreased and every private hospital in the District of Columbia is receiving compensation for every case that is hospitalized.

Coordinated with the first two units of the Medical Economic Security Administration of the District of Columbia, which have just been described, is group hospital service. This is a piece of community machinery, again predominantly controlled by the medical society of the District of Columbia. This nonprofit, cooperative service provides a maximum of twenty-one days of hospitalization, which includes hospital facilities, but no medical care or service, to groups of employes of ten or more at a rate of $9 a year. This method releases funds of the static and limited income class when they require hospitalization, the funds being utilized to defray the cost of medical care.

In the words of the editor of the *Evening Star,* of Washington, D. C., and quoted from an editorial in that paper in which much of the machinery I have just described was depicted:

> The medical and dental societies will have no reason to fear the socialization of medicine if they can offer adequate public service through *more* efficient organization within their own professions.

It is a matter of history that private enterprise, private initiative and private ambition can always do a better job than governmental bureaucracy.

It has been the contention of the men who have given the time and the thought and the energy to the creation of Washington's way out of medical economic chaos that certain simple, sound, fundamental principles in the form of normal machinery can be augmented and added to through the creation of adjunctive abnormal machinery to properly coordinate existing community resources and form the new vehicle by which to gage today's and tomorrow's methods of adjusting every individual American citizen in that community to meet his or her necessities in the form of adequate medical, dental and hospital care. St. Louis has already installed the Medical-Dental Service Bureau, patterned after the one originated in the District of Columbia, and group hospital service is shortly to follow.

You heard Dr. Leland state that the American Medical Association has a plan, the old individual plan, the plan that has been established in American cities and American lives from the inception of this country, the old idea and principle, which is a good one, that you pay for what you get and get what you pay for. The Medical Society and the Dental Society of the District of Columbia have accepted that fundamental plan and enlarged on it merely to the extent of creating such abnormal machinery, under their own jurisdiction and control, as will make it possible for all Americans to get what they pay for and pay for what they get, in accordance with their individual ability to pay for it.

Government's place in the picture of medical economics is no different now from what it ever has been in a democracy, and should be no different tomorrow from what it was yesterday. The poor have always been with us, and un-

less the Bible is wrong, always will be with us. They are with us now in greater numbers than they ever have been before. There is no necessity for this being a static situation. Consequently, there is no reason for creating machinery which can never be done away with once it is created in order to take care of this temporary situation. Government's place in the picture is to take care of the wards of the government, the poor. In the District of Columbia, the medical and dental societies have created the machinery through which this can be done. If the Government wishes to take care of the entirely forgotten man, or the indigent, let it merely make the money available, and this professionally controlled machinery can get ten times the service for the needy people out of that amount of money without administrative overhead or political patronage being involved.

There is no such thing as Utopia. There is no such way as an easy way out of anything, but there is a way out of everything. The sound and permanent and nondestructive way is always the hard way. Ultimately, the hard way is the successful and permanent, as well as the simplest, way.

It is easy to "sell" anybody on an easy way out. There are millions of minds and intellects in this country being drugged and doped with schemes for an easy way out of economic difficulty. The medical and dental professions themselves stand out as the best antidote providers.

We frequently hear the phrase from sociologists in this country that even in our heyday of prosperity, at the peak of our best times, the United States, as far as medical care was concerned, was twenty-five years behind that of other countries or certain other countries. I talked before a group of people in a little county of 150,000 population not far from Washington. I heard the expression which I have just quoted, made by a very fine speaker, a welfare worker, who does a tremendous amount of good for the community, and who if properly connected with other people who know how to do a tremendous amount of good in their own way, could do a big job for the public. In reply to this gentleman, I said, "Here is a telephone directory of your own city. Do you know that in the entire country of Belgium, with a total population of about eight million people, the telephone directory is not the size of this classified directory of yours? Do you know the number of registered automobiles in your own county, with only 150,000 population, is greater than the total automobile registration of that entire country of eight million people? When I go down to your beautiful city over the white ribbons of concrete highway and see the colored boys and girls from your southern environs driving along in automobiles, and hear on top of that that the United States is twenty-five years behind European countries in social security, I cannot but think that perhaps if we were 125 years behind European countries in social security, we would more quickly arrive at the much talked of Utopia in this country."

It is utterly impossible for me to go into the details of the Washington Plan of seeking a way out of medical economic chaos. The fundamental working principles are based on coordination of existing community resources, cooperation of the professions and both public and private agencies, creation, by and for organized medicine and dentistry in the community, of certain adjunctive abnormal machinery to augment already existing normal machinery, and, most important of all, education. We must remember that the best way out of any difficulty is

to utilize only about 10 per cent inspiration and 90 per cent perspiration. The thing that is wrong with most of these modern panaceas, or schemes, is that they are trying to find something that will work on the basis of 100 per cent inspiration and no perspiration.

Common sense is no different today from what it was 100 years ago. Common sense, two generations, one generation, many generations ago in this country, caused us to grow into a hardy state, with a willingness to utilize only 10 per cent inspiration and perspire the other 90 per cent. We need no new philosophy in this country. The things that make for domestic simplicity and domestic happiness are the same today as they were yesterday. You have no new way of showing your affection for your family. If you would communize one element of American economics—medical economics—you should communize it only after completely communizing the entire economic and social life of this country. Medical and dental societies of the District of Columbia have dedicated their system and machinery to create order out of economic chaos on one sound American principle: "In dealing with Americans' medical economic problems, we will not deviate from our original American principle and system; that is, in accordance with American customs and American traditions whereby American citizens pay for what they get and get what they pay for, we will make it possible for them to do so according to their individual ability so to do."

I believe that the two professions, working together, can actually accomplish more in a way of creating machinery for provision of medical economic security, not only for themselves, but also for the people that they serve, than any other group of people, be they sociologists, theorists or politicians. Your association, being the younger, may perhaps be the more aggressive.

I am reminded of the time when I was in high school and, in order to secure money, sold adding machines. At that time, one company was selling a large keyboard machine. Another came out with a ten key machine, which sold like hotcakes. The former came out with the slogan that it was the first in the field of adding machines. The second company came back with the slogan, "To have been first is a sign of antiquity. To be first is a sign of progress."

The leadership of organized medicine and dentistry is the thing that must be looked for. They have to fearlessly champion the cause of Americanism and the American people at this time. They have to call on the American people to exercise that good old thing intestinal fortitude and a stiff backbone.

The slogan regarding getting what you pay for and paying for what you get in accordance with your ability to pay for it is American. Only the professions that have standards, ethics and ideals and have perspired over those inspired ideals can lead the way out of economic chaos. It is not so difficult in solution if you put your shoulder to the wheel. You can do it in the good old American way, with the stamp of the United States of America on it. You can do it with quantity for all people as well as with quality for all people. I think the final slogan should be, in regard to ministering to the American people, as far as health service is concerned, first, last and always: "Of the professions, by the professions of America for Americans."

THE "WASHINGTON PLAN"

By SEYMOUR A. WATSKY, D.D.S., New York City

THE "Washington Plan" was inaugurated by the medical and dental societies of the District of Columbia to forestall the rising menace of clinic, insurance and socialistic medical care in the United States. It was designed as a panacea for all of the ills of medicine, dentistry and mankind in general. Nevertheless, in the short period of its operation, it has proved successful far beyond the dreams of its sponsors. Similar projects are now being organized in other American cities.

To begin with, a committee on coordination was formed by the medical and dental societies of the District of Columbia. The committee felt that if they themselves would promptly provide the machinery for administering satisfactory medical and dental service to those of the public who wanted it and who, for various reasons, did not receive it under existing methods of distribution, political bureaucrats could find nothing better to offer. Consequently, control of the distributing machinery would remain in the hands of those best qualified to administer to the public health; namely, the physicians and dentists themselves. All, or practically all, of the money spent by the public directly and indirectly, through taxes and charity, would be spent for service. The greater part of it would not be absorbed by parasitic middle-men engaged in the operation of unnecessary, unwieldy politically controlled distributing bureaus as proposed in plans for social security, state medicine and voluntary or involuntary health insurance.

The coordinating committee found that many people in Washington patronized clinics and hospital free wards because of ignorance as to where else they might obtain services at reasonable cost. They did not know that physicians and dentists on hospital staffs were not paid. Nor were they willing recipients of charity after the situation had been explained to them.

Upon this premise, the committee secured the cooperation of the local association of hospital superintendents and the board of public welfare. Financial assistance was provided by public welfare and voluntary hospital funds. A clearing house, designated as the "Consolidated Permit Bureau of the Board of Public Welfare" was set up. All applications for free and part-pay hospital and clinic treatment were cleared through this bureau and the local retail credit association. The service started Jan. 10, 1935. Within nine months, it proved to be astonishingly successful. Twenty two per cent of the applicants for charity care were reallocated to their own complete satisfaction and that of the institutions to which they had applied. Sixteen per cent paid the costs of their treatment and hospitalization in full. The income from private hospital beds increased 11.2 per cent. There was a 21 per cent decrease in the amount drawn by the voluntary hospitals from their donated funds. This excellent showing is expected to improve as time passes and the bureau becomes better established.

The school dental clinics in Washing-

ton, D. C., are operated by the department of health. They are equipped to render only 20 per cent of the service needed by children unable to pay. By means of the Consolidated Permit Bureau, children of well-to-do families are weeded out. Admissions to all dispensaries are checked by the bureau. The poor children benefit by receiving a greater proportion of the care to which they are rightfully entitled. Dentists benefit by the added income derived from the erstwhile interlopers in the free clinics. Everybody is happier.

The Medical-Dental Service Bureau, incorporated as a nonprofit benevolent association, is another Washington enterprise. To start, a loan of $1,000 was advanced by each of the two parent groups. They, the organized physicians and dentists, operate it in connection with the local credit bureau. Prospective patients who think they cannot afford treatment are shown by the bureau's family budget experts how to arrange for payment out of income. Installment payments are collected by the bureau. Fees are remitted to the doctor as collected, less a service charge of 10 per cent. The patient pays no interest, the bureau makes no profit. Only 1.6 per cent of patients thus far have failed to pay on time.

The difference between the income of the bureau (derived from the 10 per cent discount on collections) and the overhead is set up as a sinking fund. There now is $7,500 in this fund—a remarkable showing for the short period of operation. Patients are advised by the well-trained employes of the organization that the best type of medical and dental treatment is the most satisfactory and the cheapest in the long run. They are led away from dangerous procrastination and are glad of the opportunity to pay out of income.

Of course, there are a certain number of persons whose incomes are so limited that they require special consideration. They, too, are entitled to adequate care. The bureau, therefore, explains the patient's situation to the doctor, who is asked what his lowest fee would be, the payments being budgeted over as large a period of time as the circumstances require. The work is done immediately. The doctor receives a small but often welcome remuneration for his services. The patient does not become a public charge. Whenever, through continued serious illness or further loss of income, conditions become so bad that the patient cannot meet even these small payments, the doctor receives his installments as they fall due out of the sinking fund. No doctor is required to accept any patient on these terms. It is entirely a voluntary proposition. In Washington, if the figures are correct, between 2 and 5 per cent of the limited income class fall into this latter category. They are designated there as the "catastrophics."

This plan offers several of the advantages of the "Low Cost Dentistry Plan" advocated by me in the March, 1931, issue of the *New York Journal of Dentistry*. Through its investigation features, it prevents well-to-do patients from preying on charitable institutions and doctors. It makes it possible for persons with limited incomes to secure satisfactory care and pay for it themselves, thereby retaining their self-respect. It provides a source of additional revenue for doctors whose time is not fully occupied. It is a superior alternative to socialistic schemes for administering medical care to the masses. It has the added advantage of paying for itself and of not setting up arbitrary fee scales. It is worthy of careful consideration and quick action by the medical and dental professions.

CURRENT LITERATURE

Presence of Sensory Nerve Cells in Central Root of Trigeminal Nerve (G. A. Peters, J. Comp. Neurol., 62:349, 1935): Examination of the central roots of trigeminal nerves shows that, with few exceptions, the roots are not made up purely of nerve fibers, but also contain nerve cells in varying numbers. The cells are believed to be sensory, because they possess characteristics of sensory nerve cells found in the semilunar ganglion. The presence of sensory nerve cells in the central root proximad from the point of surgical section, the peripheral processes of which may regenerate, provides an adequate explanation for the return of sensation reported in many cases in which operation was performed for the relief of trigeminal neuralgia. The knowledge of the existence of nerve cells in the central root of the trigeminal nerve has a practical application. Severance of the central root at the pons, instead of immediately proximad from the semilunar ganglion, should prevent the return of sensation observed after the usual surgical intervention for trigeminal neuralgia.

ALTON D. BRASHEAR.

Treatment of Cancer of Lip (H. E. Martin, Am. J. Surg., 30:215 [Nov.] 1935): Surgery and irradiation are considered as complemental, not competitive, treatments for malignant tumors. Superficial lip lesions are treated by irradiation, with the unfiltered radon bulb in very early growth and with contact application of filtered radon held in a modeling compound moulage for more advanced cases. In moderately advanced cases, contact application of radon alone should not be depended on, but should be supplemented by radon implants. Deeply infiltrated lesions are treated by surgical incision. Cervical metastases are considered as a separate problem. The technical methods for the treatment of cancer of the lip at Memorial Hospital, New York City, are described in some detail.

HAMILTON ROBINSON.

Radiation Therapy for Malignancy of Tongue (I. I. Kaplan, Am. J. Surg., 30:227 [Nov.] 1935): Treatment of cancer of the tongue is considered in five phases: mouth hygiene, external therapy, local treatment of the primary lesion, treatment of adjacent lymph nodes and general health care. Since malignancy is more rampant in the presence of mouth infection, radioresistance is increased by infection and bad dental conditions may be the chronic irritation factor in tongue malignancy, it is important that bad teeth be removed and irregular dentures and rough teeth be eradicated. Extractions should be carried out before radium is applied. The removal of adjacent teeth not only simplifies the application of radium but also eliminates harmful secondary irradiation from metallic fillings. Among the complications that may follow irradiation of the tongue are necrosis of soft tissue and bone, development of necrotic ulcers, extreme pain, locking of the jaw due to trismus, secondary ray necrosis from metallic fillings or dentures, bone necrosis following postirradiation extraction of teeth, abscess of the tongue and edema of the pharynx and glottis.

HAMILTON ROBINSON.

Surgical Repair of Cleft Palate with Special Reference to Lengthening Soft Palate (H. S. Vaughan, Am. J. Surg., 31:5 [Jan.] 1936): The author classifies cleft palates into seven groups on the basis of the degree of the cleft and the structures involved in embryologic development. The importance of a knowledge of the vascular supply of the involved parts, in order that the operator may guard against necrosis and consequent tissue loss, is stressed throughout the article. It is shown that the operator must not only repair the em-

bryologic malformation but also obtain the maximum improvement in the already defective speech. In complete clefts, either unilateral or bilateral, it is advisable to operate as early as the child's physical condition permits. Usually, this is in from two to six weeks and should include the approximation of the alveolar border and the harelip. At this time, the bones are pliable on the slightest digital pressure. All sutures are carefully placed in order to avoid the tooth follicles and prevent unnecessary malocclusion. The remainder of the cleft is to be closed by a second operation. The author finds 2 or 3 years of age to be desirable, as the erupted teeth cause alveolar development with arching of the palate and thus more soft tissue with which to work. A complete description is given as to the operative procedures employed. One of the main points stressed is the provision of sufficient soft palate length in order to prevent defects of speech. The operative procedure follows very closely the Langenbeck technic.

M. W. McCrea.

Review of 1933 and 1934 Literature on Fractures: Fractures of Jaw (Barbara B. Stimson, Surg., Gynec. & Obst., 62:14 [Jan.] 1936): Fractures of the jaw are being treated by oral surgeons more and more because of the increasing acceptance of intra-oral appliances. The literature on fractures of the lower jaw consists chiefly of descriptions of various types of dental splints. Such authors as Dunning, Mack and Connely, Holler and Citoler are opposed to elastic traction as it allows a certain amount of motion. Careful mouth hygiene is urged by all, because of the extreme danger of infection. For the same reason, Dunning, Cavina, Dubov and Citoler believe that operation should be avoided when possible. Two types of operations are described: (1) the insertion of Kirschner wires to hold the fragments in place without plaster or other fixation (Ipsen) and (2) bone grafting in cases of loss of substance (Cavina). Dunning discusses the treatment of fractures by the use of cap splints, interdental splints and wiring of the jaws, on a basis of his experience in over 1,000 cases. Fractures of the upper jaw are less common than those of the lower, and in most instances can be treated conservatively (Jezek). Axhausen discusses the operation necessary for the correction of old deformities. Fractures of the zygomatic process usually require operative repair, reduction with a hook or wiring of the fragments (Dubov, Gill).

J. Frank Hall.

Hemolytic Streptococci from Nose and Throat (Ronald Hare., J. Path. & Bacteriol., 41:499 [Nov.] 1935): Hemolytic streptococci, isolated from the nose and throats of apparently well patients are classified by the author by the group precipitin reaction. He finds that almost all of the strains found in severe human infections belong to one group (Group A—Lancefield), which makes up about one-third of the total number of strains of hemolytic streptococci isolated. On the average, 7 per cent of normal persons in England have these Group A strains in the upper respiratory tract. The author feels that, for practical purposes, hemolytic streptococci not belonging to Group A may be considered harmless for man. This should prove of value to those engaged in handling of milk, practicing midwifery, performing surgical operations, etc. Unless such persons carry Group A strains, they are not likely to be potential sources of infection.

M. K. Hine.

Susceptibility of Rat to Dental Caries. VI Influence of Orange Juice and Acid-Base Balance of Diet (Theodor Rosebury and M. Karshan, Arch. Path., 20:857 [Dec.] 1935): This work was undertaken because several theories of the etiology of dental caries are based on the theory that disturbance of the acid-base balance of the body is reflected as augmented acidity or impaired neutralizing power either of the saliva or "tooth-fluids." As it has been shown that chemically identical diets, physically altered by grinding, are without the caries-producing effect which they may have exhibited before, the authors attempt to demonstrate experimentally whether a

diet with an alkaline ash can produce caries. Eighty-four rats were fed various diets including the basal caries-producing diet (containing 10 mesh rice), alone, and modified with orange and lemon juice (12+1) fed *ad libitum* in place of water; with a synthetic citrate mixture having the acid-base properties and sugar content of the orange-lemon juice; with rice completely replaced by lima beans and with rice partially replaced by lima beans. From acid-base property calculations of the diet, p_H and carbon dioxide measurements on the animals' plasma, p_H measurements on the urine and microscopic study of the jaws and teeth, the authors draw certain conclusions. The orange-lemon juice mixture fed *ad libitum* with the caries-producing diet did not reduce the incidence of caries, but resulted in an increase of doubtful significance. A synthetic citrate mixture duplicated this result to a lesser degree. Replacement of enough of the rice by dried lima beans to produce a mixture with definite alkaline ash did not result in a significantly lower incidence of caries. Employment of a rice-free lima bean diet did not allow survival beyond the twenty-two days of feeding used for the experiment, but produced a typical fissure-caries lesion in a rat that survived only seven days of the experimental feeding.

HAMILTON ROBINSON.

Unusual Cutaneous Reaction to Procaine Hydrochloride (S. S. Robinson, Arch. Derm. & Syph., 32:922 [Dec.] 1935): A case is reported in which an intracutaneous injection of 1 c.c. of 2 per cent procaine hydrochloride into the right wrist of a 30-year-old woman resulted in marked reaction. Twelve hours after injection, a severe burning and pruritis was noted about the site. An oval, defined, elevated vesicular area about 3 cm. in diameter appeared, three thin linear stripes made up of tiny vescicles extended up the forearm and the right epitrochlear gland became slightly enlarged. Subsequent questioning revealed a history of sensitivity to various pollens. Two years previously, no reaction had resulted from an injection for dental procedures. The dermatitis subsided after five days with local application of soothing lotions. The author suggests careful questioning before administration of procaine hydrochloride, especially where local reaction might extend to the brain.

HAMILTON ROBINSON.

Surgical Aspects of Treatment of Carcinoma of the Tongue (E. M. Livingston and H. Lieber, Am. J. Surg., 30:234 [Nov.] 1935): There are many preventable fatalities from carcinoma of the tongue chiefly the result of failure to recognize and eradicate precancerous lesions, failure to identify epithelioma at a sufficiently early stage, temporizing with doubtful lesions, procrastination with small but fully established malignancies, inadequate attack on the primary lesion and extravagant sacrifice of tissue in mild cases, with high immediate mortality. Since leukoplakia alone is an etiologic factor in 35 per cent of all buccal cancer, the authors recommend excision when response to the removal of local irritation is not prompt. Biopsies, often from more than one area, are advised. The surgical treatment for precancerous lesions and localized epithelioma is illustrated and described in detail. Surgical procedures, electrosurgical and cautery, and irradiation therapy are included in the treatments considered.

HAMILTON ROBINSON.

FOREIGN LITERATURE

Two Cases of Rhabdomyoma of Tongue (H. Parreira and J. Nunes de Almedia, Arg. de patol., 6:582, 1934; abstr. Surg. Gynec. & Obst., 62:36 [Jan.] 1936): Of 3,096 cases of tumors diagnosed by the authors, only two cases were found to be rhabdomyoma, and they both were found to occur in the tongue. After reviewing the literature, they found that only twenty-four cases had been reported. They describe in detail the histological findings and supplement them with photomicrographs. One of the cases was that of a 16-year-old girl and the other that of a 51-year-old woman. The first case differed from all reported cases of rhabdomyomas. Because of its macroscopic appearance and frequent

hemorrhage accompanying its development, it could easily have been mistaken for an angioma. Histological examination showed that it was made up of striated muscle tissue and presented syncytial masses in the interpapillar spaces. This tumor was thought to be originated from displaced embryonic tissue. In the second case, the parenchyma was made up almost entirely of syncytial masses and cells of granular protoplasms. This tumor is believed to be developed from preexisting muscle fibers as the result of loss of differentiation of highly differentiated tissue.

J. FRANK HALL.

Minnett Apparatus in Dentistry (G. F. Rawdon Smith, Brit. M. J., Dec. 7, 1935): G. F. Rawdon Smith, a physician in Liverpool, states that the Minnett gas-air machine has been so successful in his hands as an analgesic agent that he suggests it seemed possible that it might also be useful in dental surgery where a general anesthetic is not required. He further states that it has been tried out at the Liverpool Dental Hospital and found to work admirably. It eliminates the painful sensation of the drill working over a nearly exposed root pulp or in the sensitive dentin near the gum margin. It is an ingenious and almost "fool-proof" apparatus.

J. FRANK HALL.

Surgical Technic Anesthesia—Brief and Prolonged Narcoses with Evipan-Sodium in Children (Wien. klin. Wchnschr., 1:529, 1935; abstr. Surg. Gynec. and Obst., 62:14 [Jan.] 1936): Evipan-sodium is a barbituric-acid derivative which is administered intravenously in 10 per cent solution. In the hands of an expert, this intravenous anesthesia is controllable. The author has used it in many cases of surgical and orthopedic operations. Most of the children were prepared by administration of morphine and atropine. The anesthesia was always started after complete preparation in the operating room; then, 4 c.c. of the solution was injected into an arm vein during the first minute at the rate of 1 c.c. in fifteen seconds. If an additional amount of solution was needed, it was injected more rapidly at the rate of 1 c.c. in ten seconds. With these amounts, intended for brief anesthesia, the author has obtained complete narcosis for as long as twenty-four minutes. On slow injection, the children suddenly stopped screaming and fell asleep. In older children, a slight trembling was often observed. Convulsions or severe motor disturbances were entirely absent. In cases of cyanosis, due to overdose, coramin was administered and the cyanosis disappeared.

Evipan-sodium was found to be especially advantageous for cleft palate operations. J. FRANK HALL.

Mucous-Gland and Salivary-Gland Tumors (Huga Ahlbom, Brit. M. J., 3911: 1213 [Dec. 21] 1935): Of the many eminent services rendered by Stockholm Radiumhemmet to scientific radiotherapy, probably none is more widely appreciated than the issue of that series of monographs which appears as "Supplementa" to the *Acta Radiobilogica.* The twenty-third of these, on mucous-gland and salivary-gland tumors is a clinical study containing an analysis of the material accumulated at Radiumhemmet in over twenty-five years. It deals with the familiar tumors as well as those much rarer tumors which occur in connection with mucous membranes supplied with serous, seromucous and mucous glands. Dr. Ahlbom opens with a historical review of the subject, then proceeds to an account of the special characteristics of the tumors, followed by a classification under their various histologic types. Under the title "The Material at Radiumhemmet" are included 254 cases which have been treated from the opening of the clinic in 1909 until the end of 1932. The method of treatment included the use of massive doses of radium. Radiation is clearly explained. According to Radiumhemmet statistics, definitely malignant mucous and salivary gland tumors occur about equally in men and women. The benign and semimalignant types occur more frequently in women (65 per cent) than in men (35 per cent). The average age was 43 for those

having the benign and semimalignant, contrasted with 52 for those having the malignant, lesions. Of the malignant growths, 25 per cent were reported as completely healed and the patients free from recurrence after five years. With earlier diagnosis, the author hopes that these results may be improved. There is a full discussion of the various methods of treatment, including surgical and electrosurgical operations and radiotherapy.

J. FRANK HALL.

MISCELLANY

BOOK REVIEW

Vincent's Disease, Pyorrhea and Allied Subjects. A Practical, Illustrated Postgraduate Course of Instructions for Students, General Practitioners and Specialists in Dentistry and Medicine. By I. Disraeli, D.D.S. 181 pages, 91 illustrations and 3 charts. Price, $6.00. Published by Dental Research Publishing Co., Los Angeles, Calif.

The first forty pages of this book are taken up with the description of disease processes and the technic of preparing specimens, etc. Chapter XI consists almost wholly of roentgen-ray films, "from personal records," fifty-one in number, without a single legend to describe them, the author taking the unique position that each one is self-explanatory. This may be flattering to the reader, but it is hardly in keeping with usual procedure, and not at all enlightening to the not inconsiderable number of people who may be the least bit lacking in perception. The reviewer would suggest that, in future editions, the author waive his assumption of superiority on the part of the reader and take it for granted that the reader is not blessed with such keenness of insight. At least a few legends might be enlightening. The author makes a very proper plea for early diagnosis, a matter that cannot be emphasized too frequently. He also makes the optimistic statement: "Several facts concerning Vincent's disease are certain; namely, once the treatment is begun, the ulcers can be healed, the pain relieved and the objective symptoms removed within several days' time." But later in the book, the following statement is made: "Treatment must be continued permanently, or the disease will relapse into its former condition." The latter half of the book has nothing to say about Vincent's disease, but is taken up with such subjects as pyorrhea, erosion, materia medica, diet, light therapy and economics.

BOOK RECEIVED

The National Formulary. Sixth edition. Prepared by the Committee on National Formulary by authority of the American Pharmaceutical Association. Official from June 1, 1936. Published by the American Pharmaceutical Association, Washington, D. C., 1935.

CORRESPONDENCE

To the Editor: I have delayed writing you regarding your editorial in the June issue of THE JOURNAL, "A Prevalent Threat." You ask what the threat is. Others may answer that. From my experience and observation I believe, "It is all ready within the walls." Many of us have given time and money in securing dental service to relieve the worthy poor and to keep such relief within the guidance of the dental profession. It has been, I am sorry to say a grievous disappointment. There seems to be no definite line of demarcation between the worthy poor dental service directed by the dental profession and such service as taken over by health and educational departments, school authorities, lay organizations and hygiene, trade and industrial propaganda. In April, 1931, the governor of New York State vetoed a dental bill (his third veto of such bills). This ruined

three years' work of the committee appointed by the dental society of this district and resulting in the presentation of this bill, which would have corrected the present conditions. I believe it would be most practical for many localities to consider a program keeping the work local and within the guidance of the dental profession, thereby eliminating duplication and waste, and helping to buttress American fundamentals of government, which are slipping to many dangerous positions.

FREDERICK W. PROSEUS, D.D.S.,
315 Alexander Street,
Rochester, N. Y.

"THE COIL SPRING"

To the Editor: In the December, 1935, JOURNAL, there appears an article on "The Coil Spring," by E. B. Arnold. As one who has introduced the stainless steel coil spring (for orthodontic treatment) in this country, and has done an appreciable amount of work with it, I feel justified in making a few constructive comments. By way of reference, I wish to mention an article on "Various Uses of Stainless Steel Coil Springs in Orthodontic Treatment," which I presented in the *Dental Cosmos,* February, 1935.

To begin with, I believe that Dr. Arnold deserves a great deal of credit for the many excellent uses that he has shown for coil springs in orthodontic treatment. Although I agree with him that, like all orthodontic appliances, they cannot be universally employed, I feel that they should be used wherever practically possible. My reason for this is that there is no other orthodontic appliance within my knowledge which enables the operator to regulate the amount of pressure to be exerted on any given tooth or teeth so carefully and exactly as does the stainless steel coil spring.

After experimenting with hard-drawn spring wire of base metal, and one of low gold content which was used by optical companies (for the manufacture of the small springs on the nose clips of eyeglasses), I found that they all were oxydized very readily in the mouth. Although coils made of gold platinum were an improvement, it was not until I discovered the stainless steel coil spring that I found one which I believe is most satisfactory in every way. Its use in orthodontia was first shown in this country at a clinic which I gave before the Dental Society of the State of New York, May 14, 1931.

At the outset of his article, Dr. Arnold says that he first tried 0.022 gold platinum wire, which was "too drastic in its force." This phrase is not very clear, for a coil made of 0.022 inch wire would have practically no elasticity, and therefore no force to speak of. As a matter of fact, many orthodontists find 0.022 inch wire sufficiently thick for use as the main labial and lingual arch wires.

Dr. Arnold says that he tried stainless steel coils, and prefers to use precious metal exclusively, because "they seem to give a gentler and more delicate pressure." I do not agree with this statement, for the simple reason that it cannot be proved to be the fact. By gentle or more delicate pressure, Dr. Arnold evidently means less pressure. In other words, he means that precious metal coils are less elastic than stainless steel coils. This is true, for it is an established fact that hard drawn stainless steel wire is tougher and far more elastic than precious metal wire. This fact, of course, is not altered after this wire is wound into coils. Since this is so, a thicker precious metal wire (which is less delicate) must be used to produce the same amount of pressure as a thinner stainless steel wire. On the second page of his article, Dr. Arnold himself says that he had to reduce the size of his stainless steel wire from 0.010 to 0.008 inch. Does he mean to imply that this lower gage steel wire produces greater pressure than the 0.010 inch precious metal wire which he uses and recommends? If so, why doesn't he use a still thinner than the 0.008 inch steel wire (which would of course be still more delicate)?

In my practice, I have tried stainless steel coils of the following gages: 0.007 inch, 0.009, 0.010 and 0.012 inch. I have found that coils made of 0.009 and 0.010 inch hard drawn stainless steel wire were

the most satisfactory. The 0.007 inch wire was too weak for pushing (or pulling), as it offered too little resistance to compressibility. The 0.012 inch wire on the other hand offered too much resistance to compressibility.

On the third page of his article, Dr. Arnold says he compresses the coil springs (which he buys in 1 foot lengths) to "take any excess spring or deadness out" of it. It is my opinion that a properly wound coil spring should never be tampered with, by either compressing or pulling apart. In both instances, such tampering will distort or damage it, thus reducing its efficiency.

A spring manufacturer winds my stainless steel coils by machine, so that the rings of the coil are uniformly spaced throughout. The spacing of the coil is not tampered with. The operator simply cuts off the length of coil that he desires, for it must be noted that the closer the rings of the coil are compressed, the "deader" or less elastic it will become.

Further, Dr. Arnold says, "The coil may be opened with the finger for the desired amount of pressure." Here, again, I wish to point out the folly of tampering with a properly wound coil spring. The crude manner of opening it with the finger is certain to distort and damage it. If a longer coil is desired, is it not better simply to cut off a longer piece of coil than to distort and damage the short piece by stretching it?

In summarizing, I wish to say:

1. Dr. Arnold deserves a great deal of credit for showing many interesting uses of coil springs in orthodontic treatment.

2. Since hard drawn stainless coil springs are more elastic than precious metal ones, a thinner wire may be used, which makes them more delicate.

3. Stainless steel does not become oxydized in the mouth; whereas, precious metal does to some extent.

4. Stainless steel is much less expensive than precious metal.

5. Stainless steel coils may be more uniformly and properly wound by machine, and may be best used by simply cutting off the proper length desired.

6. Under no circumstances should a properly wound coil spring be distorted and damaged by compression or stretching with the fingers before using.

SAMUEL HERDER,
230 West Seventy-Ninth Street,
New York City.

WHAT'S IN A NAME?

To the Editor: An interesting and stimulating article appeared in the July number of THE JOURNAL, entitled "First Permanent Molar: Its Condition at Birth and Its Postnatal Development" by Rudolf Kronfeld, of Chicago.

All believers and supporters of prophylactic odontotomy are pleased to note that Dr. Kronfeld most thoroughly upholds them in their advocacy for the earliest treatment of all noncarious pits and fissures. On page 1153, Dr. Kronfeld makes the following statement:

"I fully agree with the postulate that until we know more about the cause and prevention of dental decay, prophylactic filling of the fissures is of paramount importance to the maintenance of dental health in the present-day civilized races."

Prophylactic filling is commonly known throughout the dental world as "prophylactic odontotomy," and I am heartily in accord with the statement of Dr. Kronfeld regarding the paramount importance of this procedure because I believe that prophylactic odontotomy is preeminently superior to all other dental operations.

I wish that Dr. Kronfeld had devoted more space to the elucidation of his reasons for supporting prophylactic odontotomy. There are undoubtedly a few members left within the profession who sincerely doubt the wisdom, or the ethics, of cutting into a fissure which does not show any signs of decay, believing it may be the solitary one in 2,500 that will not become the vehicle in which decay will start. Had Dr. Kronfeld given the scientific facts for his belief in, and his support of, this operative procedure, it would have hastened the entrance of many into the bright and happy fields of preventive dentistry, particularly for children. It is only in dentistry for

children that the greatest prevention can be obtained.

While I fully appreciate the excellent work of Dr. Kronfeld in showing the prevalence of fissures existing in the teeth, I am at a loss to understand clearly his reasons for suggesting that fissures are not faults, flaws or defects.

A fault is that which impairs the excellency of a thing. It shows an imperfection, a blemish, as "the faults of this horse." In mining, a fault is shown by a break in the continuity of the material.

"A fissure is a narrow opening." Any opening in the surface of the enamel impairs the excellency of its protection for the internal structure and vital parts. Such a blemish is a fault.

Imperfect human bodies "are so frequent that they may well be regarded as a common occurrence; yes, even a normal condition." Who would question this statement? But does it change in any way the terminology regarding the quality or condition of these human bodies? We can also state that imperfect trees "are so frequent that they may well be regarded as a common occurrence; yes, even a normal condition." This is also true. How seldom do we find a tree so fortunately situated that all its branches have had room to grow to their full size? And when this does happen, we are delighted to behold the beauty and symmetry of this tree.

On page 1155, Dr. Kronfeld states: "There is no justification for the common assumption that fissures are defects or faulty formation, since fissures occur regularly and normally in perfectly formed molars and bicuspids, in prehistoric men and in recent primitive as well as civilized races. The high incidence of caries in the fissures of modern man cannot be taken as proof that fissures are defects."

Dr. Kronfeld's error is his belief that any one has applied the terms fault, flaw or defect to certain formations of the tooth *because* decay is frequently found at this point. The definition of the English word "fissure" is a "narrow opening." The term fissure is applied to any narrow opening found in rocks, stones, teeth or anywhere else. A fissure is also known as a fault, a defect and a flaw. Therefore, the terms fissure, fault, flaw or defect are applied to this natural or usual formation whenever and wherever found, be it in a rock, stone or tooth; quite regardless of decay. In fact, decay has nothing whatsoever to do with the correctness or even the creation of the definitions of the word fissure. Because of the formation of certain parts of the tooth, this descriptive term has been applied. The English dictionary is the accepted authority for the definition of words.

When there is no decay, many members of our profession are lost and bewildered like men in a fog. They do not know what to do or how to treat teeth with no decay.

There can be no question that the shape or form of a tooth, particularly the formation of the different surfaces, has a direct relation with the possibilities and probabilities of decay. Undoubtedly, the environment of the teeth, the conditions within the mouth, have an important bearing on the etiology of caries. But none of the many factors in the problem of caries, or even in the location of caries, warrants us to change the definitions of words. Therefore, quite regardless of any relation that caries may have with fissures, or how frequently caries is found therein, neither the presence nor the absence of caries can change or does change the fact that fissures are faults, flaws or defects.

If we use the word "normal" to mean usual, undoubtedly first permanent molars with fissures are normal or usual; but this does not and cannot change the accepted definition of the word fissure.

It had been believed that the aborigines of South Africa, because of their wonderful sight, had perfect eyes. A number of careful examinations were made and, to the surprise of all, perfect eyes were few. The majority had this or that defect. Because these defects were usual, it was not suggested to call them by some other name or to change their definition.

A cause is a power or efficient agent pro-

ducing something. It is doubtful that a fissure is an agent in the production of decay. When geologists speak of a "fissure" in the rock as being a "fault," a "flaw," an "imperfection in the continuity of the structure," there is no discussion as to its being common or uncommon, natural or unnatural. If this fissured rock is to be used as a foundation, engineers at once take steps to start operative procedures to prevent future trouble.

And so with fissures in the protective covering of the teeth. That they are not the agent which produces decay is no reason for not calling them faults or defects. A rose will smell just as sweet if we call it by some other name, and fissures are just as dangerous even though we may call them normal or usual or by some other term.

On the other hand, if we do not call them faults or defects which mar the protectiveness of the enamel, we have no standard for the perfect tooth. To destroy the ideal would be a catastrophe.

A thing which is normal or usual does not arouse apprehension or fear. We do not anticipate any danger in that which is normal or usual.

Quite contrary is our reaction to a defect, or a fault. Here is a condition which demands attention and calls for correction. When we are fully conscious of the real menace to the life of the pulp and the relation of this pupal condition to the health of the patient because of the presence of a fault or defect in the protective armor of the tooth, quite regardless of how frequent these defects may be, we recognize our obligation to practice "safety first," even though no decay is seen.

In 1835, Mr. Robinson, of London, used the term "aperture" in referring to fissures, or holes. The implication of danger is not conveyed by the use of the term "aperture." In all probability, this may be the reason so little preventive attention has been given to these perilous and dangerous apertures during the past hundred years, and so little instruction given to dental students regarding the "paramount importance" of their early care. This is shown by the few credit points that students receive for pin hole fillings. Although "prophylactic fillings" are of supreme importance, having the highest rank of all operative work, and are of the greatest value to the patient, the skill of the student in making a mesioclusodistal filling obtains greater recognition and he receives a greater number of credit points.

There is ample justification both logically and etymologically for calling fissures defects, faults or flaws. Fissures or faults are not found in perfectly formed molars, just as fissures, faults or flaws are not found in perfectly formed rocks, diamonds or other precious stones.

In conclusion, I trust that, for the sake of our children and for the usefulness and reputation of our profession as a beneficent and important health service to humanity, every reader of this article will forever remember Dr. Kronfeld's advice that "prophylactic filling" of fissures is of paramount importance.

THADDEUS P. HYATT, D.D.S., F.A.C.D.,
New York City.

NEWS

Harvard Dental School Appointments: Appointment of five new members of the faculty of the Harvard Dental School was announced December 19. Four of the men were named assistants in operative dentistry: Russell H. Carpenter, East Providence, R. I., D.M.D., Harvard, '34; Duane H. Clarridge, Nashua, N. H., D.M.D., Harvard, '26; Robert M. Furfey, Brookline, D.M.D., Harvard, '25, and Charles F. Sprague, Boston, D.M.D., Harvard, '11. Robert G. Rae, Brockton, D.M.D., Harvard, '18, was appointed instructor in oral surgery. At the same time two members of the dental school faculty were promoted. Arthur P. Young, instructor in operative dentistry, will be assistant professor of operative dentistry for three years, from Sept. 1, 1935; and Arthur M. Maloney, assistant professor of prosthetic dentistry, will be associate professor of prosthetic dentistry. Five members of the dental faculty were reappointed for three

years from Sept. 1, 1935. They are Leon E. Dulac, and Harold E. Tingley, assistant professors of operative dentistry; Harold A. Kent, assistant professor of oral surgery; Richard B. Smith, assistant professor of prosthetic dentistry, and Clarence B. Vaughan, assistant professor of clinical dentistry.

Dr. Winter Honored: The Rhode Island State Dental Society at its annual meeting in Providence, January 16, conferred a medal and scroll on George B. Winter, St. Louis, for an "outstanding contribution to dentistry and humanity."

DEATHS

Baugh, Hubert O., St. Petersburg, Fla.; Atlanta Southern Dental College, 1914; died October 31; aged 49.

Beatie, Alfred Lee, Oregon City, Ore.; University of Michigan, College of Dental Surgery, 1895; died November 1; aged 64.

Clarke, Thomas Patrick, Cascade, Iowa; St. Louis University School of Dentistry, 1909; died October 18; aged 50.

Hall, Norman B., Kalamazoo, Mich.; Chicago College of Dental Surgery, 1898; died recently.

Hodgson, Edward S., East St. Louis, Ill.; Washington University School of Dentistry, 1904; died recently; aged 59.

Peckelis, John Joseph, Newark, N. J.; School of Dental and Oral Surgery of Columbia University, 1915; died November 16; aged 45.

Schlueter, Frank F., Watertown, Wis.; Marquette University School of Dentistry, 1910; died October 30; aged 52.

Seccombe, Wallace, Toronto, Canada; Royal College of Dental Surgery; died January 16; aged 57.

Stearman, Lee Roy, Springfield, Ill.; Indiana University School of Dentistry, 1915; died November 6; aged 47.

Wasson, Arthur S., Sioux City, Iowa; died November 12; aged 77.

Wenker, Raymond J., Milwaukee, Wis.; Chicago College of Dental Surgery, 1891; died October 24; aged 67.

Wilson, James Mathew, Greene, Iowa; State University of Iowa, College of Dentistry, 1907; died recently; aged 61.

Wilson, George W., Delmar, Iowa; died November 1; aged 67.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, San Francisco, Calif., June 29-July 3.

American Association of Dental Schools, Louisville, Ky., March 16-18.

American Board of Orthodontia, St. Louis, Mo., April 17-18.

American Society of Orthodontists, St. Louis, April 20-23.

Chicago Dental Society Midwinter Clinic, February 17-20.

Eastern Association of Graduates of Angle School of Orthodontia, New York City, February 17-18.

Five State Post Graduate Clinic (Maryland, Delaware, Virginia, West Virginia and North Carolina), Washington, D. C., March 8-11.

American Dental Society of Europe, August, 1937.

International Dental Congress, Vienna, August 2-8.

Philadelphia County Dental Society (in combination with Pennsylvania State Dental Society), Philadelphia, February 4-6.

Texas State Dental Society and Texas Association of Oral Surgeons and Exodontists, Dallas, June 8-12.

University of Buffalo School of Dentistry Alumni Association, February 12-14.

Society for the Advancement of General

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

District of Columbia at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

American Dental Assistants Association, San Francisco, June 29-July 3.

STATE SOCIETIES

February

Minnesota, at St. Paul (25-27)
Pennsylvania, at Philadelphia (4-6)
Oregon, at Portland (4-7)

April

Alabama, at Birmingham (14-16)
Connecticut, at Stamford (15-17)
Kansas, at Salina (27-29)
Kentucky, at Louisville (6-8)
Louisiana, at Baton Rouge (26-28)
Massachusetts, at Boston (28-May 1)
Michigan, at Detroit (20-22)
Mississippi, at Greenville (13-15)
Montana, at Butte (16-18)
New Jersey, at Atlantic City (22-24)
Washington, at Seattle (30-May 2)
Wisconsin, at Milwaukee (21-23)

May

Arkansas, at Little Rock (11-13)
Georgia, at Atlanta (11-13)
Illinois, at Peoria (12-14)
Indiana, at Indianapolis (18-20)
Iowa, at Des Moines (5-7)
Maryland, at Baltimore (4-6)
Nebraska, at Lincoln (18-20)
New York, at New York City (12-15)
North Carolina, at Pinehurst (11-13)
North Dakota, at Bismarck (11-13)
Tennessee, at Memphis (4-6)
South Dakota, at Sioux Falls (4-6)
Utah, at Salt Lake City (21-23)
Vermont, at Burlington (13-15)
Virginia, at Roanoke (4-6)
West Virginia, at Fairmont (18-20)

June

Colorado, at Denver
Maine, at Portland (26-27)
Missouri, at St. Louis (8-10)
New Hampshire, at Sunapee (29-30)

October

Florida, at Orlando (5-7)

November

Puerto Rico, at Mayaguez

STATE BOARDS OF DENTAL EXAMINERS

Colorado, June 23-27. David J. Tepley, 807 Republic Bldg., Denver, Secretary.

Florida, at Jacksonville, June 22-26. H. B. Pattishall, 351 St. James Bldg., Jacksonville, Secretary.

Mississippi, at Jackson, June 16. T. Ford Leggett, Laurel, Secretary.

New Jersey, June 29-July 4. John C. Forsyth, 148 W. State St., Trenton, Secretary.

AMERICAN DENTAL ASSOCIATION

The Seventy-Eighth Annual Session of the American Dental Association will be held in San Francisco, June 29-July 3.

FRANK H. MCKEVITT, *Vice Chairman, Publicity Committee,*
450 Sutter St.,
San Francisco.

STATE OF NEW JERSEY BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY

The New Jersey State Board of Registration and Examination in Dentistry will hold its annual examinations, commencing June 29 and continuing for five days thereafter. On application to the secretary, a copy of the requirements and rules, instruction sheet and preliminary application blank will be sent. Any person desiring to apply as a candidate must file the preliminary application, together with the examination fee of $25, on or before March 15 for the succeeding June examination or before September 1 for the succeeding December examination.

JOHN C. FORSYTH, *Secretary,*
148 W. State St.,
Trenton.

THE AMERICAN BOARD OF ORTHODONTIA

(CHANGE OF DATE)

The American Board of Orthodontia

will meet in St. Louis, Mo., April 17-18, instead of April 20, as previously announced.

CHARLES R. BAKER, *Secretary*,
636 Church St.,
Evanston, Ill.

EASTERN ASSOCIATION OF GRADUATES OF THE ANGLE SCHOOL OF ORTHODONTIA

A regular meeting of the Eastern Association of Graduates of the Angle School of Orthodontia will be held February 17-18 at the Waldorf Astoria Hotel, New York City.

E. SANTLEY BUTLER, *Secretary*,
55 Locust Ave.,
New Rochelle, N. Y.

TEXAS STATE DENTAL SOCIETY AND TEXAS ASSOCIATION OF ORAL SURGEONS AND EXODONTISTS

Two Lone Star State conventions will afford an opportunity to those attending to see the Texas Centennial Exposition, which opens in Dallas, June 6. Meeting simultaneously, June 8 to 12, will be the Texas State Dental Society and the Texas Association of Oral Surgeons and Exodontists. Included in the extensive program being planned by Dallas members of the two groups are many special events and amusements for the entertainment of the visitors. Sports and social events will play an important part. Of particular interest to the profession will be the medical and health exhibit of the Federal Government, which will be placed in the United States Building at a cost of $40,000. Elaborate medical, dental and pharmaceutic exhibits showing the latest in equipment, supplies and methods will be displayed in the Hall of Varied Industries by various private corporations.

CHICAGO DENTAL SOCIETY STUDY CLUB

A week of postgraduate instruction is offered by the Chicago Dental Society Study Club preceding the annual Midwinter Clinic of the Chicago Dental Society. Courses will be offered in Conduction Anesthesia, Exodontia and Minor Surgery; Partial Dentures, Crown and Bridge Work; Oral Surgery, Radiology and Anesthesia; Nitrous Oxide Anesthesia; Full Dentures; Restorative Dentistry, and Children's Dentistry. Additional information can be obtained by addressing

D. W. ADAMS,
185 N. Wabash Ave.,
Chicago.

F. D. I.: NINTH INTERNATIONAL DENTAL CONFERENCE, VIENNA, 1936

Independently of the interest in the scientific side of the Ninth International Dental Conference, to be held in Vienna, August 2-8, those attending will be able to view the beauties of Austria, both natural and architectural. A judicious use of their time will allow those attending the Congress to enjoy all its program and also to see all points of interest in Vienna and the surrounding country.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

The Twelfth Annual Meeting of the American Dental Assistants Association will be held at San Francisco, June 29-July 3. For further information, address

LUCILE S. HODGE, *General Secretary*,
401 Medical Arts Bldg.,
Knoxville, Tenn.

PASADENA DENTAL ASSISTANTS ASSOCIATION

The next meeting of the Pasadena Dental Assistants Association will be held at the Alpine Chalet, 951 E. Green St., Feb. 13, at 6:30 p.m.

INA BRANSON, *Secretary*.

OFFICERS AND TRUSTEES OF THE AMERICAN DENTAL ASSOCIATION
1935-1936

PRESIDENT

George B. Winter.....Frisco Bldg., St. Louis, Mo.

PRESIDENT ELECT

Leroy M. S. Miner.....363 Marlborough St., Boston, Mass.

VICE PRESIDENTS

Frederick J. Wolfe.....Maison Blanche, New Orleans, La.
Fred R. Adams.....80 West Fortieth St., New York City
Homer B. Robison.....Rorabaugh-Wiley Bldg., Hutchinson, Kan.

SECRETARY

Harry B. Pinney.....212 E. Superior St., Chicago, Ill.

TREASURER

R. H. Volland.....First Capital Nat'l Bank Bldg., Iowa City, Iowa

BOARD OF TRUSTEES

George B. Winter, President, Ex-Officio.....Frisco Bldg., St. Louis, Mo.
Leroy M. S. Miner, President Elect, Ex-Officio.....
.....363 Marlborough St., Boston, Mass.
Harry B. Pinney, Secretary, Ex-Officio.....212 E. Superior St., Chicago, Ill.
R. H. Volland, Treasurer, Ex-Officio.....
.....First Capital Nat'l Bank Bldg., Iowa City, Iowa
C. Willard Camalier, '38.....1726 Eye St., N. W., Washington, D. C.
Thomas L. Grisamore, '38.....29 E. Madison St., Chicago, Ill.
E. G. Meisel, '38.....121 University Place, Pittsburgh, Pa.
C. J. Caraballo, '38.....Stovall Bldg., Tampa, Fla.
George E. Morgan, '38.....2039 North Prospect Ave., Milwaukee, Wis.
J. G. Hildebrand, '37.....Waterloo, Iowa
Albert R. Ross, '37.....Murdock Bldg., Lafayette, Ind.
Oren A. Oliver, '37.....Medical Arts Bldg., Nashville, Tenn.
Philip E. Adams, '37.....106 Marlborough St., Boston, Mass.
Harvey J. Burkhart, '36.....Box 879, East Avenue P. O., Rochester, N. Y.
C. R. Lawrence, '36.....730 Bass Bldg., Enid, Okla.
Herbert C. Miller, '36.....E. 6th and Oregon Sts., Portland, Ore.
Wilfred H. Robinson, '36.....1706 Broadway, Oakland, Calif.